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NINETY • NINTH YEAR

AMERICAN Gas Journal

AUGUST, 1957

Only Magazine Published Exclusively for the Gas Utility Industry

New slow-speed AL-250 ALUMINUMCASE METER... for sustained accuracy

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Rated capacity 250 cfh of 0.64 sp. gr. gas at ½-inch w.c. differential—5 psi working pressure.

The new American® AL-250 Aluminumcase Meter operates at only 7 revolutions per cubic foot providing proven tin meter accuracy possibilities through greater power and slow-speed operation.

Every field-proven design feature pioneered by American is incorporated including oil impregnated porous bronze bearings, internal rubber grommet seals . . . PLUS

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- **LIGHT WEIGHT**—aluminum alloy pressure die-cast body reduces shipping weight . . . easy meter handling and setting.
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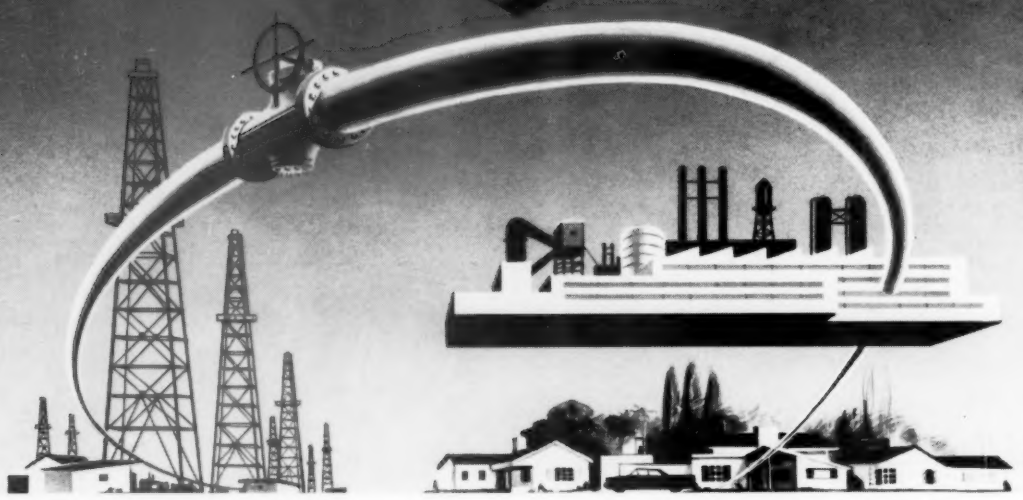

Since the first commercial gas odorant production, Oronite is proud to have become an integral part of the gas industry. Manufacturing and technical facilities have been continuously expanded through the years to fulfill the ever-growing requirements of this dynamic industry. Today, and in the years ahead, you can look to Oronite for the finest odorant products and most complete service.

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AUG 15 1957

"Our dispatching control is more efficient now that our stations are remotely controlled"

—W. H. Krammes, superintendent of central transmission, Southern California Gas Co.

Bell System remote metering and control channels have enabled Southern California Gas to convert many distribution stations to remote operation. Dispatching control is now more efficient than before the conversion was made.

"To supply a big area like Los Angeles, you have to react fast in case of a load change or pressure drop," says W. H. Krammes, chief of central transmission.

"When our stations were attended, we'd often have a ten-minute lag between a dispatcher's order and its execution. The station attendant would have to run back and forth checking meters, then relay the readings to the dispatcher.

"Today, with Bell System channels for remote metering and control, it's practically instantaneous. The dispatcher reads the telemeter, pushes a button and valves are operated at the remote station."

If your operation requires tight control, you'll be interested in communications the Bell System has developed for this job. Just call your Bell Telephone Company business office. A representative will gladly study your requirements.

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AMERICAN Gas Journal

NINETY-NINTH YEAR

GAS TECHNOLOGY — OPERATIONS — EQUIPMENT — MANAGEMENT — UTILIZATION

VOLUME 184 August, 1957 Number 8

CONTENTS

OPERATIONS & MANAGEMENT

The Sonic Leak Detector 14
L. A. McElwee and T. W. Scott

The Titrilog: Its Application to Odorization Problems 18
D. McA. Mason

Alternate Methods of Meeting Peak Demands: Economic and Engineering Evaluations 21
J. L. Oberseider

Ideas at Work: *New Technique for Fireproofing, Insulating Storage Tanks* 37

American Gas Fundamentals: *Completing the Gas/Oil Well* 38

Vacuum vs Pressure Testing of Meters 44
Hilding V. Beck

The Law: *All Reasonable Contract Provisions are Binding* 48

How To Lead Better Conferences 50
Another in the series helping you "Toward Better Management"
Alfred M. Cooper

LOAD BUILDING

Gas-Fired Unit Heaters 33
What you should know about their application and operation
Myron W. Ryder

NEWS AND FEATURES

Memo from the Editors 3
MCF 4
American Gas Fundamentals 38
Coming Events in the Gas Utility Industry 47
The Law 48
Toward Better Management 50
Things to Write For 54
New Gas Utility Equipment 56
Peak Shavings 59
Gas Utility Industry News Events 60
Gas Utility Industry Associations' News 61
Men at Work 64
Advertisers' Index 66

YOU CAN GET MORE INFORMATION on 33 new and useful ideas or items of equipment developed for the gas utility industry. You'll find them on pages 54 through 58 . . . and to get more free information, use the handy reader's Ready-Reply Card bound in this issue. There's an extra card for your neighbor, too!

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Memo From The Editors

In This Issue . . .

Now you can "listen for leaks," using a new device developed by the research department of United Gas Coporation. This "sonic leak detector" uses a microphone and has a unique "crawler" to move it through a main. Difference in sound level determines location and probable intensity of leak. Turn to page 14.

Your nose is usually a good "sensor" in detecting a leak — because the gas contains an odorant. But what's the right amount of odorant? That's where the nose fails and the Titrilog takes over. It's an instrument that gives continuous, instantaneous readings and can prevent over- or under-odorization. How it works is explained on page 18.

What's the best way to meet peak demands? The answer can — and usually is — a many-faceted thing. You'll find useful data on the subject in J. L. Oberseider's article, beginning on page 21.

Don't overlook the gas-fired unit heater as a first-class load builder. They have many applications, come in a variety of sizes and types to meet all needs. Pointers on their use are outlined starting on page 33.

Which is better — vacuum or pressure testing of meters? Both methods give satisfactory results if proper techniques are employed. See page 44.

Back by popular demand is the interesting and informative legal page, THE LAW, penned by Leo T. Parker, well known attorney-at-law and AGJ contributing editor on gas utility industry legal problems. Contracts are discussed this month, on page 48.

Make your conferences worth while! Whether you conduct or just attend conferences in the office or field, you'll find some helpful ideas on how to get more from them in Alfred M. Cooper's article on page 50.

Letters

EDITOR:

I read with real delight, on page 4 of your AMERICAN GAS JOURNAL of July, the paragraph starting off, "Ninety-nine years."

I don't blame you a darn bit for being proud of your magazine's ninety-nine years of service to the gas utility industry. What's more, I want to congratulate you most sincerely on your magazine's attainment of such a fine old age. We in this industry owe you and the good folks who have been associated with your magazine over the years a real debt of gratitude.

Your loyalty to the industry and your continuing efforts for its betterment, over the years of its great growth, have been most outstanding and always beneficial.

I know you will agree with me when I say that, like the gas industry, your magazine is not old except in birthdays. Your past growth is but a down payment on the years to come. With the kind of work which you continue to do for the gas industry, I can say, along with someone else, "I predict that present levels are mere road signs to future heights far beyond the fondest hopes and dreams of you and your associates."

Again, congratulations, and all good wishes.

C. S. Stackpole,
Managing Director
American Gas Association

★ ★ ★

This and That

Perforated Pages. While visiting gas utility engineers and operating men in their offices around the country, we have often been asked why we didn't do something to make it easier for a reader to tear out articles for filing. Of course, you could just rip out the page or use a knife, but as readers point out, this is a messy operation.

So we decided to do something about it for our readers. In this issue of AGJ you'll find perforated pages for the first time in any gas industry publication. Only the section containing the technical and operating articles is perforated. This real time and effort saver is an inducement to save desired articles for future reference.

★ ★ ★

Pass-alongs, photo-copies, and personal copies. During these travels around the country, we've noted some strange practices in gas utility offices and libraries.

For instance: In one large company, when an engineer or operating man wants a copy of an article — instead of just tearing it out of the magazine — he has to go to considerable trouble.

Company rules say "don't tear it out — have it copied." So, he sends the magazine to the reproduction department where copies are made — at a cost of 40 to 50 cents per page.

In this particular office are about 15 engineering and operating men. This office receives only one copy of each trade publication — each a "pass-along" that goes from desk to desk (the journey sometimes takes several weeks). On many occasions, several engineers want copies of different articles in each publication. This happens every month.

Imagine the total cost to reproduce 10 articles a month, each averaging three pages, and making copies for three engineers. Conservative estimate by one engineer in the office was about $40 to $50 — an annual cost of about $500.

At least one-third of these articles come from one publication. This company is spending one-third of $500 ($166.66) each year to copy articles from this publication. For $45 a year, each of these 15 men could receive a personal copy of the publication. He could then tear out any article he wanted for his files — and the company could save $121.66 annually.

★ ★ ★

We might point out that under the copyright laws, it is illegal to reproduce copyrighted material without express permission of the copyright owner.

★ ★ ★

Handbook. While on the subject of personal copies, let us hasten to point out that the 1957 AMERICAN GAS JOURNAL Handbook Issue will be ready September 15. The Handbook is sent to all regular subscribers at no extra cost as the 13th issue of AGJ. It isn't sold separately. This new 35th edition has been completely revised, with 40 new pages of tables, charts, graphs, and other data added.

—The Editors

★ ★ ★

More natural gas from Canada for the West Coast is proposed in two plans announced in the past month. Pacific Gas & Electric plans to construct a $330,000,000, 1300-mile line from gas reserves in Alberta to the San Francisco Bay area. Initial deliveries of 400,000,000 cu ft per day would begin in 1960. A recently organized Canadian subsidiary of PG&E has purchased a substantial quantity of the gas needed for the project, PG&E officials said. The project would require authorizations from the government agencies of Alberta and Canada, the FPC, and the California PUC.

In another plan, Southern California and Southern Counties Gas Companies propose to purchase an additional 200,000,000 cu ft daily from El Paso Natural Gas Company, with one half to be delivered in 1959 and the balance in 1960. El Paso would receive the gas from Pacific Northwest Pipeline Corporation, which is contracting for gas from Western Canada. To deliver the gas, El Paso will build a 500-mile, 34-in. line from a connection with Pacific Northwest near Twin Falls, Idaho, to a point on the California state line near Las Vegas, Nevada. The two California companies would build another 200 miles to deliver the gas to its distribution facilities.

Continued protection for the gas industry's coveted "Blue Star" approval seal granted appliances meeting rigid performance standards is seen in a recent Federal Court decision penalizing a California water heater manufacturer for unauthorized use of the AGA seal of approval. Judson J. Whitehead, Jr., Oakland, was fined $5000 and each of two firms he headed — Jud Whitehead Heater Company and Hynes & Cox Electric Corporation — was fined $2500 for violating a permanent injunction issued in 1953. The court also turned down the defendants' application for future use of the AGA seal of approval because of "defendants' repeated violations of the injunction." Further violations, warned Federal Judge Oliver J. Carter, would result in imprisonment.

Regulatory notes. In Florida, Governor Collins has signed a bill designed to permit taxation of municipally-owned utilities when they operate in competition with private companies . . . Utah's state road commission has been advised by the Utah attorney general's office to disregard a 1957 state law requiring the commission to pay public utility relocation costs required by road realignment or widening until the law has been tested in court . . . Pennsylvania's legislature has given final passage and sent to Governor Leader a utility relocation bill requiring state reimbursement for costs of moving utility facilities when necessitated by federal aid highway construction.

Distribution system construction to serve 10,000 new customers is underway in three Saskatchewan cities served by Saskatchewan Power Corporation, highlighting the firm's 1957 program. Largest of the systems will be in Regina, where more than 5500 customers have signed up for natural gas. Systems are also being built in Kerrobert and Wilkie. In Regina, 1,700,000 ft of pipe, ranging from ¾ to 18-in., will be laid. Some 25,000 ft of main will be laid in Kerrobert and 60,000 ft in Wilkie.

Construction expenditures by the gas industry will reach a record $2.13 billion in 1957, an increase of 37 percent over 1956's all-time high of $1.55 billion says the AGA. Gas utility expenditures in 1957 for new construction will be over $660 million. Transmission expenditures will total nearly $1028 million, and $380 million will be spent by gas companies for their own production facilities. An estimated 20,000 miles of new distribution mains will be built this year, and some 10,000 miles are expected to be added to the network of transmission pipelines.

Newly organized Air Conidtioning Promotion Committee of AGA is taking immediate steps to support gas air conditioning program of all manufacturers in the field. An "idea exchange" has been organized to help utilities set up aggressive sales and service organizations within their own companies. Chairman of the committee is W. W. Selzer of Columbia Gas System Service Corporation, New York City.

"Little Inch" removal from gas service by Texas Eastern is underway. The FPC authorized the Shreveport-based transmission firm to proceed with plans for converting the war-time built line to refined petroleum products pipeline service after a federal court of appeals refused to block the conversion as asked by barge operators.

Rates. Colorado's PUC has authorized a temporary rate increase averaging 53 cents monthly for natural gas customers in the Denver metropolitan area, Pueblo, and other cities throughout the state. The higher rates apply to 232,094 customers of Public Service Company of Colorado and users served by Pueblo Gas & Fuel Company . . . West Virginia's Supreme Court has upset a 1955 state PSC order that gave United Fuel Gas Company only one-fourth of a requested rate increase. The court said, in unanimous decision, that the PSC was wrong in basing rates only on cost of gas produced in West Virginia and not considering purchases by UFG from out of state . . . Shortly after the court decision, UFG was granted a $1-million rate increase. This has been followed by an application for another $4-million increase. Company officials said UFG lost more than $4-million since 1954 because the state PSC did not grant the full amount requested, and that it could never be recovered . . . Jacksonville Gas Corporation (Florida) has received state PUC authorization to raise rates 8.52 percent, to bring its rate of return up to 4.1 percent . . . Pennsylvania's PUC has rejected a request by Manufacturers Light and Heat, Pittsburgh, for an immediate $1.5-million annual rate increase. It also suspended for six months proposals by two other western Pennsylvania gas utilities to raise rates by $1.5-million a year. The PUC has been studying a total $6.4-million rate increase request made by Manufacturer over a year ago.

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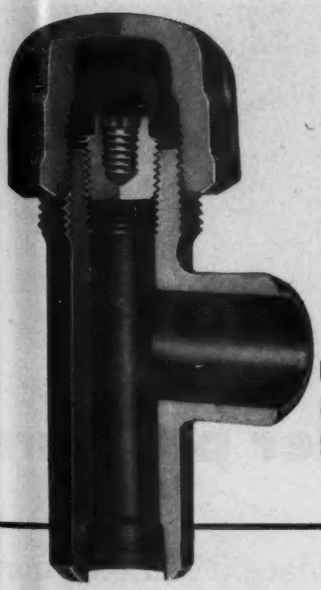
connections



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NO-BLO® SERVICE TEE

- Installed under pressure
- May be stopped-off at any time
- Activated with "E-4", "EH-1", "D-4" or "T" Machines
- Welding or threaded inlets
- Welding, threaded or Dresser outlets
- Cast iron cap for pressures to 250 p.s.i.
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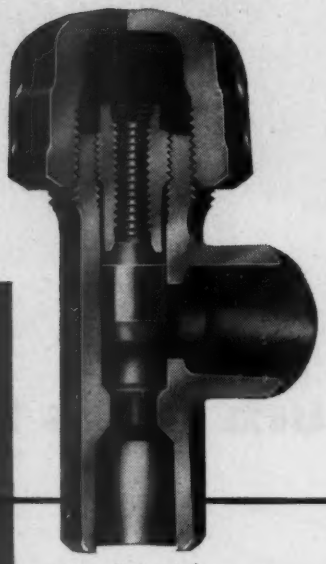

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- Installed under pressure
- Valve seats in "open" position and back-seats in "closed" position
- Differential threads develop powerful seating force
- Make stop-offs with screwdriver and wrench
- Installed with "E-4", "EH-1", "D-4" or "T" Machine
- Renew valve seat under pressure
- Welding or threaded inlets
- Welding, threaded or Dresser outlets
- Available with cast iron or steel cap
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See your Mueller Representative, consult your Gas Catalog G-97 or write direct today for full details and specifications.

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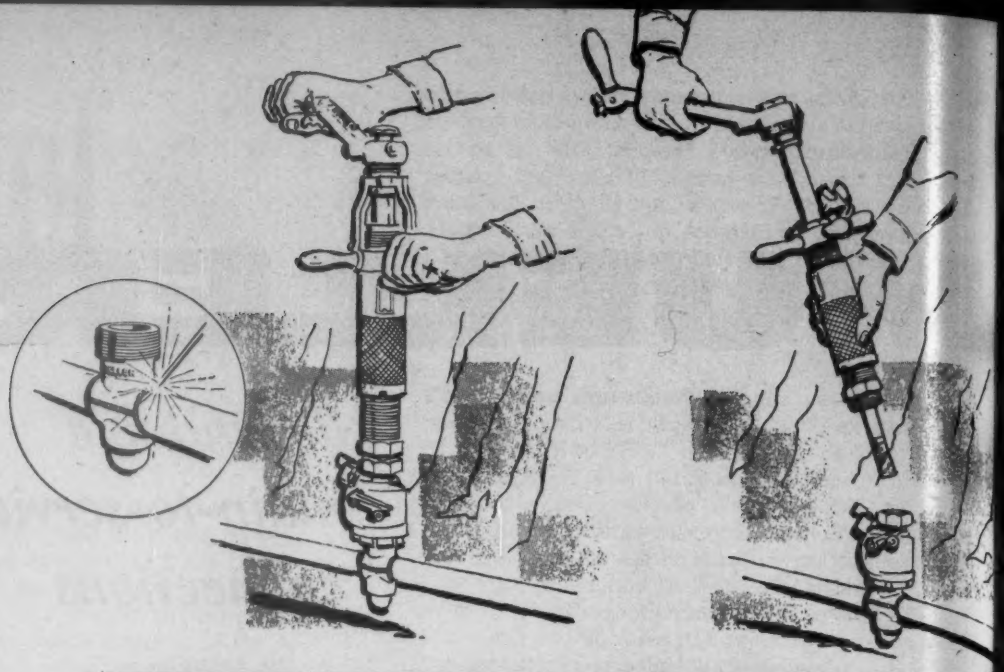


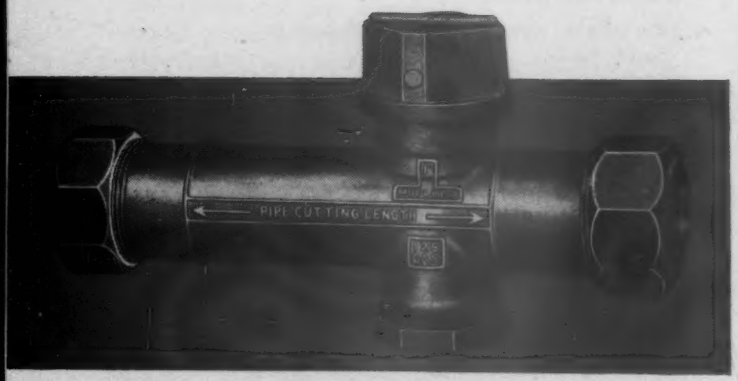
1 *drill line!*

Weld line stopper fitting to service line—at least 6" from section of line to be cut out. Attach control chamber or gate valve to fitting. Make cut through line with an E-4, EH-1, D-4, DH-2 or T Mueller® Drilling Machine.

2 *stop-off service!*

Remove drill and attach rubber sto to boring bar of drilling machine. mount machine and open valve. L stopper into fitting and expand. G now shut off in service line.

Cut in curb stops Safely under pressure



CUTTING-IN CURB STOP

- Iron Body, Bronze Key Type
- Inverted Key with "O" Ring Seal
- Straight Way
- Flat or Square Head
- Dresser Inlet with Dresser or Insulating Outlet
- Threaded Inlet with Dresser Outlet
- Pressures to 125 p.s.i.
- Sizes ¾" through 2"

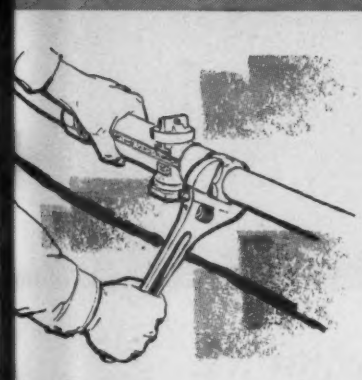
Cut out and replace leaking or frozen curb stops or install new stops in existing service lines quickly and safely without shutting off the service at the main or replacing any part of the service line.

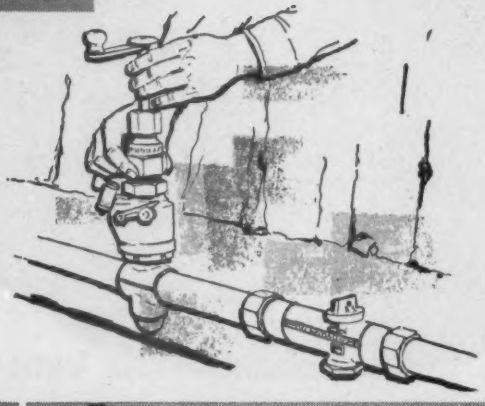
Shut-off is made right at the curb with a Mueller No-Blo® Line Stopper Fitting. A short section of line is then removed and a Mueller No-Blo Cutting-In Curb Stop is slipped into place. Only one excavation is needed!

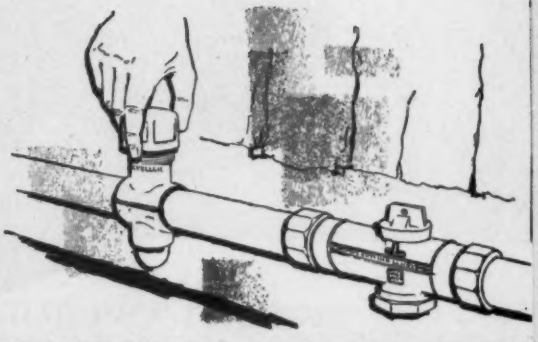
Write for the free NO-BLO® Method booklet "Make Installations Under Pressure". It shows how other gas installations are also made in complete safety.

install stop!

out short section of service line—including existing stop, if any. (Marks on body of Mueller Cutting-In Stop indicate exact length of pipe to be removed.) long end of new stop completely onto upstream on of pipe. Realign pipe and slide other end of as far as possible over downstream section.







ighten stop!

nstream section of pipe now butts against e of outlet coupling and prevents move- when stop is closed. Tighten Dresser ling nuts firmly. (When threaded inlet is used, threads hold stop in position.)

5 *plug fitting!*

Close curb stop. Relax and withdraw rubber stopper from line stopper fitting. Close valve and remove machine. Mount completion machine, with plug, on control chamber or valve. Open valve and screw plug into top of fitting. Release plug and remove machine and valve.

6 *complete installation!*

Tighten completion plug and screw completion cap on line stopper fitting. Install a Mueller Curb Box over new curb stop and backfill. Entire operation has been made under pressure without blowing of gas—in a single excavation.

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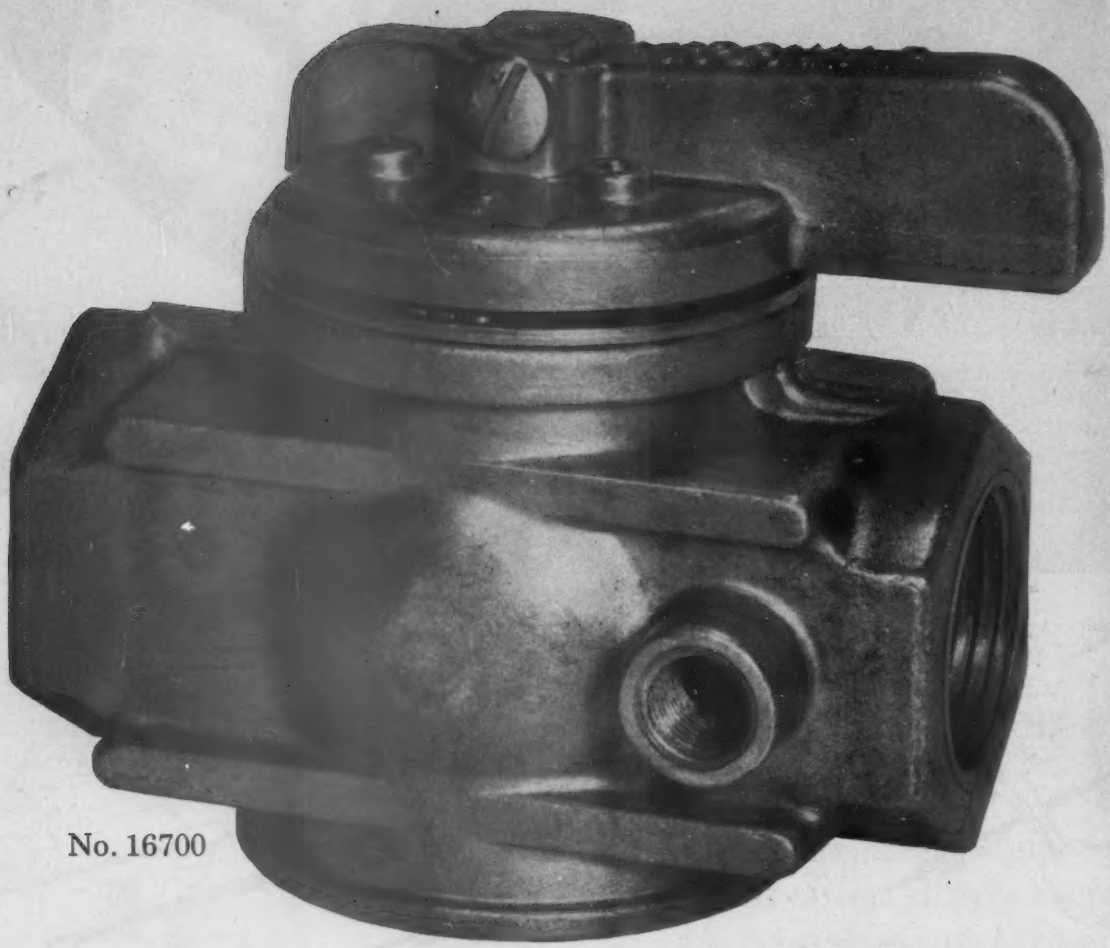

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The meter set is your company's representative on the customer's property. Meter sets can be in good taste . . . cleanly piped, well located, fabricated with modern components to reflect credit on the quality of your service. Or they can be ugly eye sores.

Do your meter sets compliment the progressive gas industry? Do they match the appearance of the new homes you are serving? Do they belong in contemporary basements or landscaped yards? Rockwell aluminum meter and regulator sets do!

Their eye appealing lines win customer acceptance . . . give the rightful impression of better service and protection from your use of the finest, safest equipment.

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The high degree of sensitivity and stability in Rockwell meters and

ACCURACY

...*that lasts, for the longest life, at the lowest cost*

regulators come from the use of advanced design principles, modern materials and many exclusive manufacturing developments.

To maintain accuracy, Rockwell has invested millions in plants and laboratories. Automatic machines, precision tooling and testing take the guesswork out of manufacture. And by grouping the production of related products in separate plants, a closely coordinated measure of quality control is achieved.

The end result is that Rockwell customers get the maximum in accuracy and durability from their measurement and control equipment plus trouble-free performance and low, low maintenance costs. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

FOUR WAYS IN WHICH ROCKWELL EXCELS

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ROCKWELL GAS METERS AND REGULATORS

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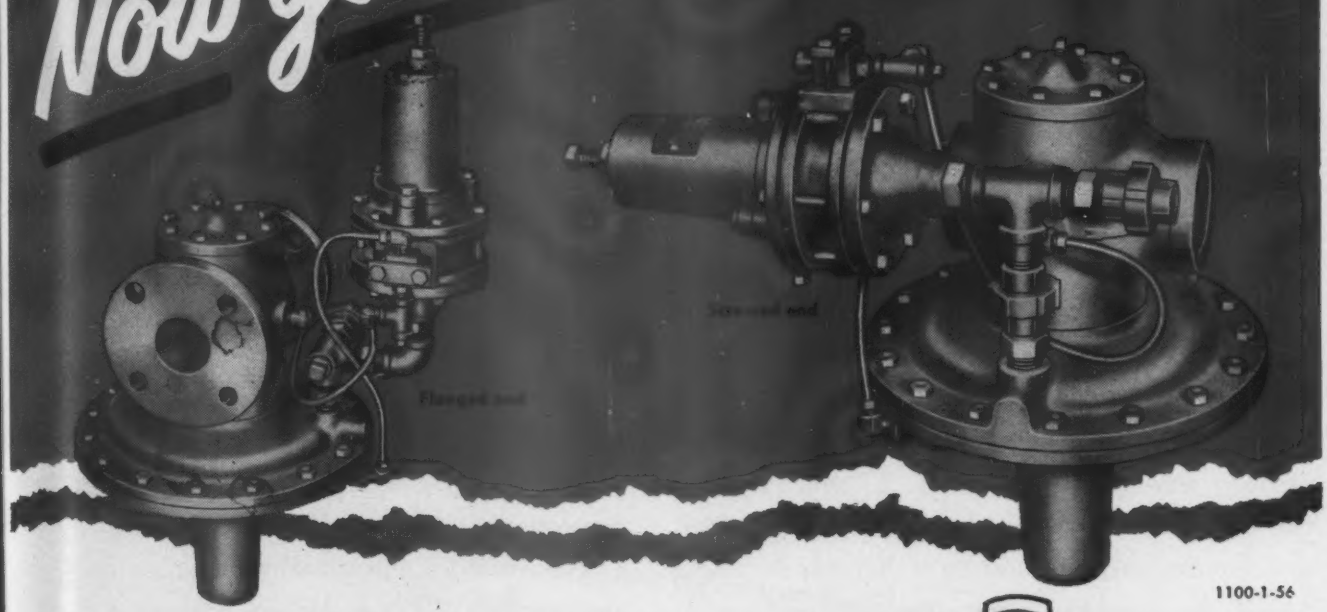

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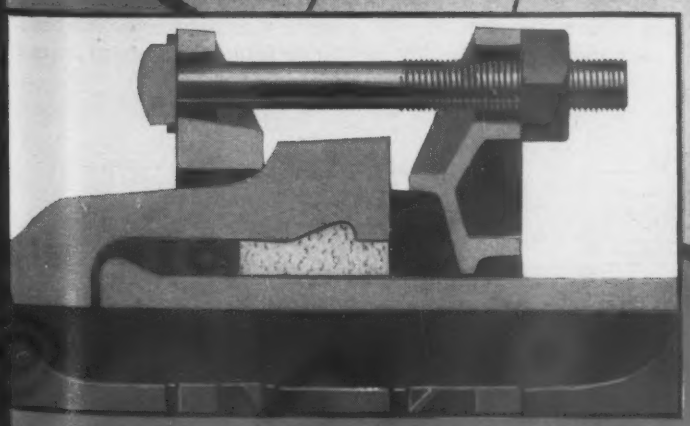

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New Device Lets You **LISTEN FOR LEAKS**

The SONIC Leak Detector

L. A. McElwee and T. W. Scott
Research Department
United Gas Corporation
Shreveport, Louisiana

GAS lost by leakage in city mains is a serious problem. From a financial point, the gas lost is a commodity that has been bought, paid for, and then transported many miles to market only to be lost rather than being sold at a profit. While this monetary loss is serious, in all probability the hazard of escaping gas in congested areas is the prime purpose in leak repairs.

To repair a leak, it is first necessary to locate the leak. There are numerous methods used by the industry to locate leaks, however, all the presently used methods are non-specific and entail considerable work and expense. At the best the location is only an approximation and entails considerable excavation and probing before the leak can be repaired.

United Gas Corporation has endeavored to find a method whereby a leak may be located more precisely so that repairs may be made with minimum effort and less inconvenience to the public from test holes and broken pavement.

Development of Detector

Preliminary consideration was given to sonic methods of locating a leak from outside the pipe. It was found that, in spite of all the theoretical and experimental sound propagation work, no one property or combination of properties of sound generated by leaks has been found upon which a leak detector could be designed to locate a leak from outside the pipe.

The only listening device in use within the industry, as far as can be determined, is the **accoustic stethoscope,** which transmits sound from a diaphragm in contact with the gas stream to the ears through a conventional medical stethoscope earpiece. This device has been used with some success in low pressure systems. At best, however, it gives only an approximation, since the information obtained is that the leak is nearest the connection when the loudest sounds are heard.

Preliminary tests were made and data recorded using a helical coil of ½-in. diameter copper tubing with taps made at intervals of 10 ft by soldering ⅛-in. brass collars to the tubing. Brass plugs were inserted in the collars and made gas tight. These plugs could be removed to install the stethoscope type listening device and the plugs could be drilled to simulate leaks on a line.

Wide-Range Microphone Added

Due to the low sensitivity and poor frequency response of the hearing aid microphone in the previously mentioned tests, it was replaced with a much wider frequency range condenser microphone system. This microphone has a small head, approximately 1-in. diameter, and can be used with up to 1000 ft of connecting cable to the oscillator demodulator unit that goes with the system.

Additional tests were made using the condenser microphone, and the characteristic frequencies of the sound received were analyzed with a frequency selective vacuum tube voltmeter. From the data obtained, the attenuation factor for the tubing was calculated and curves were plotted of sound intensity vs leak size, pressure, etc. Nothing in this data indicated any characteristics or properties of a leak that would make possible satisfactory leak detection using this method.

Experimental Results

Some conclusions drawn from the above experiments are:

1. Leak noises are direct functions of pressure and leak size.
2. Most of the sound energy of leak noises is concentrated in the low frequencies (less than 500 cycles per sec) although some high frequency energy is present (more than 5000 cycles per sec).
3. Too many unpredictable factors are involved to try to determine the location of a leak by listening at selected points and correlating sound intensity to distance from leak.

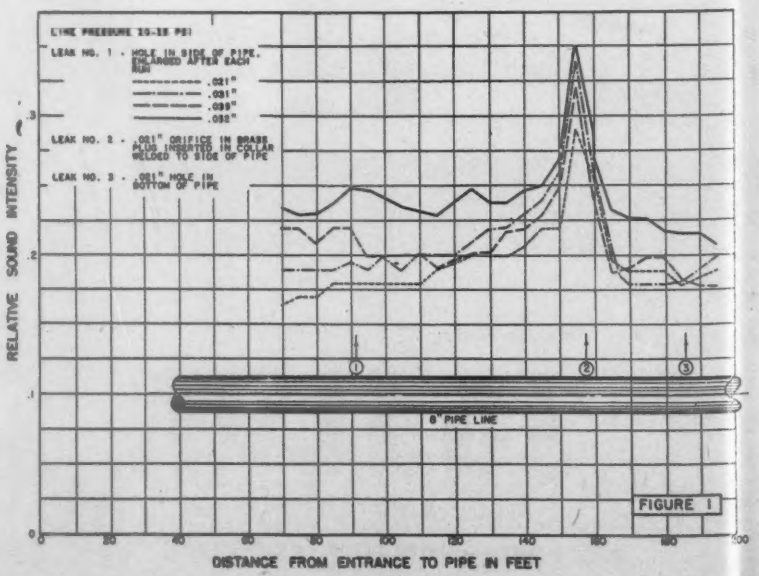

FIGURE 1

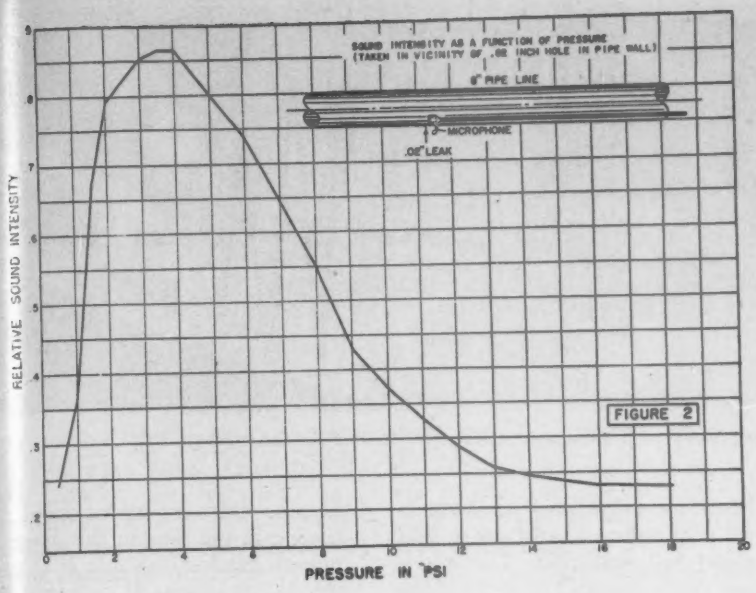
SOUND INTENSITY AS A FUNCTION OF PRESSURE
(TAKEN IN VICINITY OF .02 INCH HOLE IN PIPE WALL)
8" PIPE LINE
MICROPHONE
.02" LEAK
RELATIVE SOUND INTENSITY
PRESSURE IN PSI

FIGURE 2

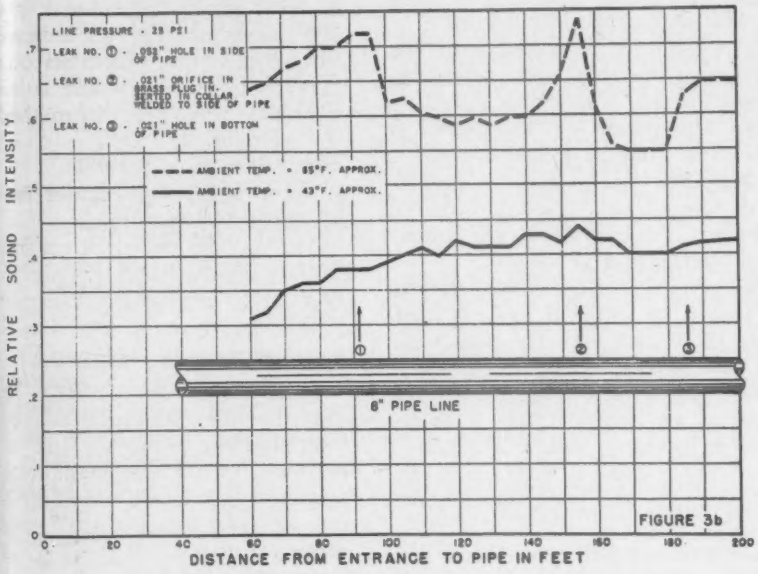
LINE PRESSURE - 25 PSI
LEAK NO. ① - .082" HOLE IN SIDE OF PIPE
LEAK NO. ② - .021" ORIFICE IN BRASS PLUG INSERTED IN COLLAR WELDED TO SIDE OF PIPE
LEAK NO. ③ - .021" HOLE IN BOTTOM OF PIPE
AMBIENT TEMP. - 85°F. APPROX.
AMBIENT TEMP. - 43°F. APPROX.
8" PIPE LINE
RELATIVE SOUND INTENSITY
DISTANCE FROM ENTRANCE TO PIPE IN FEET

FIGURE 3b

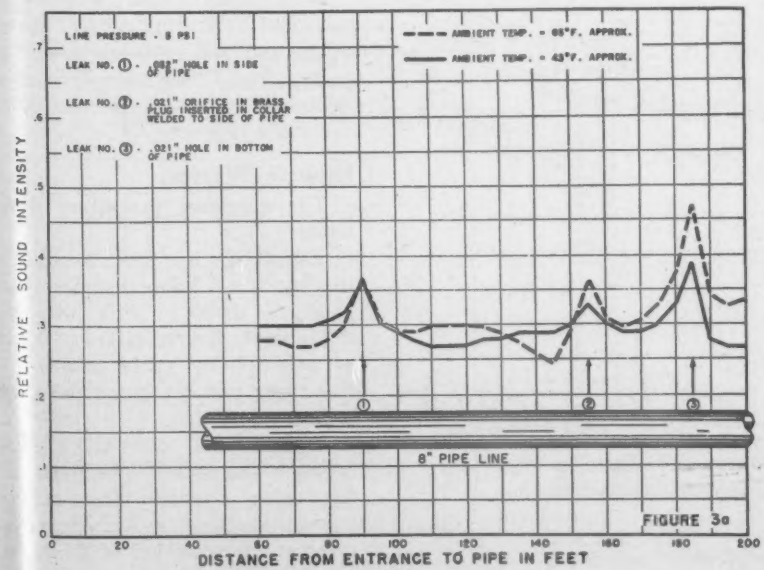
LINE PRESSURE - 8 PSI
LEAK NO. ① - .082" HOLE IN SIDE OF PIPE
LEAK NO. ② - .021" ORIFICE IN BRASS PLUG INSERTED IN COLLAR WELDED TO SIDE OF PIPE
LEAK NO. ③ - .021" HOLE IN BOTTOM OF PIPE
AMBIENT TEMP. - 68°F. APPROX.
AMBIENT TEMP. - 43°F. APPROX.
8" PIPE LINE
RELATIVE SOUND INTENSITY
DISTANCE FROM ENTRANCE TO PIPE IN FEET

FIGURE 3a

4. The only seemingly practical method of determining the exact location of a leak is to introduce the microphone into the gas stream so that it comes into the immediate vicinity of the leak.

Further Tests Needed

To further pursue the feasibility of leak detection by the introduction of the microphone into the gas stream, an 8-in. test line was installed. This line was of 8⅝-in. OD line pipe and was set on stands approximately 2 ft above ground level. It was 230 ft in length. The pipe was not insulated in any manner, having only a coat of aluminum paint applied.

A lubricator fitting was flanged to one end of the pipe so that a push rod could be introduced to move the microphone through the line. A ¼-in. pipe collar was welded to the side of the 8-in. pipe and a full opening drilled through the 8-in. pipe wall. This provided a means of introducing various size leaks into the system by drilling a ¼-in. plug to the desired size and inserting in the ¼-in. collar. The output of the microphone was amplified and sound levels read on a vacuum tube voltmeter.

From tests conducted with the ½-in. copper tubing it was determined that most of the sound energy generated by a leak was in the low frequency range of 1 kc or less. In the first experiment, the low frequencies were investigated and, while the leak could be readily heard, there was no definite peak in the vicinity of the leak. When the upper frequency response range of equipment was increased to 40 kc, a definite high peak of sound energy was apparent in the immediate vicinity of the leak. Several size leaks and various pressures gave the same results (Fig. 1). This agrees very well with theory in the fact that gas escaping through an orifice will generate some high frequency sound, and that the attenuation factor of sound in tubes is directly proportional to frequency. The high frequency energy being attenuated very rapidly leaves a leak of energy in the immediate vicinity of the leak.

Detection Related to Pressure, Temperature

Finding leaks in a system is to a degree limited by the pressure in the system (Fig. 2). The greatest noise generated is at about 4 psig and falls off with either an increase or decrease in pressure. This does not mean that leaks cannot be located at either higher or lower pressures, however.

Another condition affecting noise generation from leaks was found to be ambient temperature. Fig. 3b shows tests made with a pressure of 25 psig

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and the solid line represents a run made at an ambient temperature of 43 F. It is apparent that with the response shown it would be difficult to locate a leak. The broken line represents a run made under the same conditions with the exception that the ambient temperature was 65 F.

From this record, the indicated peaks would make it easy to locate the leaks. Fig. 3a is a similar test, however it was run with a pressure of 5 psig. The 5 psig pressure being more favorable to leak detection by the same method gives a signal that is strong enough even at 43 deg to be satisfactory; however it is evident that the signal at 65 deg gives a higher peak.

"High Pass" Filter Added

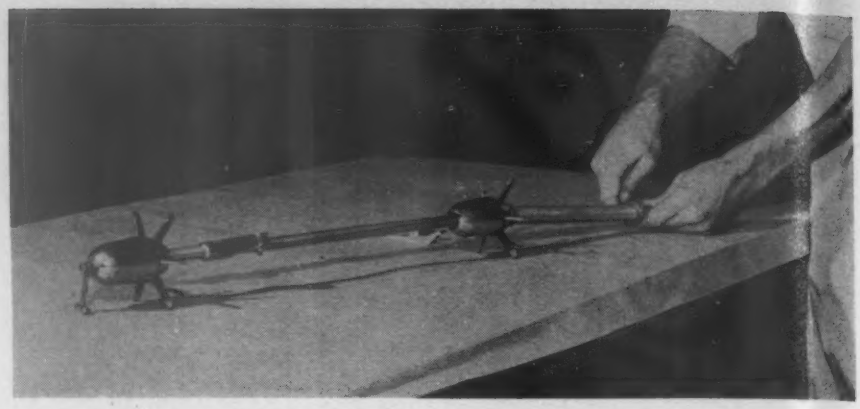
To this point, all tests were made on a "dead" line. Recognizing that, in actual practice, it would be necessary to survey lines with gas feeding into the system as well as service lines feeding out of the system, these features were added to the experimental line.

With a gas feed into the line through a regulator, reducing the pressure from 125 psig to the test levels, it was found that the noise level caused by the regulator valves was about 10 times higher than the noise level generated by a leak.

To overcome this situation, it was necessary to add a high pass filter to the microphone system. By selecting a suitable cut off, the noise generated by the regulator was eliminated leaving the high frequency peaks generated by the leak. Fig. 4 shows sound level of leaks after the high pass filter was installed and set to cut off all frequencies below 3 kc.

"Crawler" Moves Detector

At this point, the leak detector was considered ready for field testing; however, there were operating problems to be dealt with before a satisfactory field test could be conducted. The major problem was a method of moving the microphone through a pipeline for distances great enough to warrant the cost of bell hole and tap necessary to introduce the microphone into the line.



Working model of crawler demonstrates its forward-moving action.

Throughout the tests conducted, the microphone was either shoved with ¼-in. pipe through a packer or pulled by a wire. This system was recognized to be of little value in a field operation. To overcome this obstacle a crawler was designed (Fig. 5) and constructed to perform this operation. The principle of operation is as follows:

The probes *D* are carbaloy tipped and loaded by spring *B* to keep their points in contact with the pipe wall. The rear probes are rigidly attached to the body *G*. The front probes are supported on slide *F*. Slide *F* is attached to spring *A*. Slide *F* is attached at the front of cable *H*. Cable *H* passes over pulley *C* and back through the body *G*.

In operation, a pull is exerted on line *H*. The rear probes are in contact with the pipe wall keeping the crawler from moving in the pipe in the direction of the pull erected on cable *H*. The force exerted on cable *H* follows around pulley *C* and moves the front slide forward energizing the spring *A*.

When the probes *D* are carried forward by the slide *F*, the tips dig into the pipe so that when the pull on the cable *H* is relaxed, the crawler is moved forward. This operation is repeated, thus moving the crawler through the line. Cable *H* is a stainless steel airplane control cable and is very light for its strength. The limits of the crawler have not been determined but in field tests it has traversed sections of line up to 1000 ft long with no apparent difficulty.

Special Tapping Machine

Since the crawler cannot be inserted into the line through a conventional "hot" tap due to the 90° angle, it was necessary to contact a manufacturer of tapping machine and have him modify one of their conventional models to make a tap at a 45° angle (Fig. 6). This figure shows the 45° angle taps as well as the system used in launching and retrieving the crawler.

Gate valves adjacent to the line were modified by cutting off the lower half of the gate and replacing it with a neoprene plug. This is necessary since it is necessary to cut off the gas flow with the cable in place.

How It Works

The operating procedure is as follows:

The 45 deg hot taps are installed on the line at a suitable distance apart not to exceed 1000 ft. This 1000 ft spacing is due to the limitation of the length of microphone cable available. The launching and retrieving tubes are installed as shown.

The crawler is inserted in the launching tube, the packer is installed and the tap valve opened. The crawler is shoved into the line with the rod indicated at the upper left of the slide. The crawler is flexible, due to the arrange-

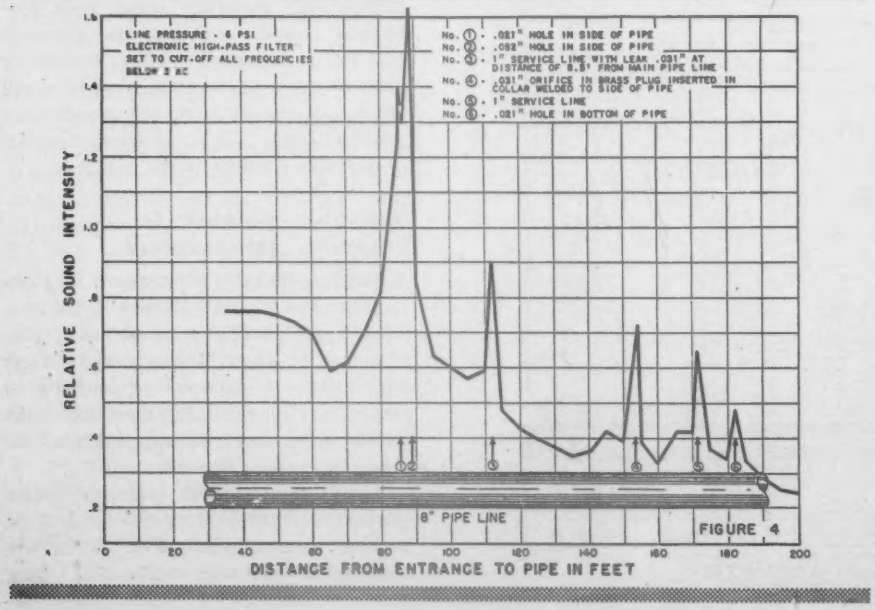
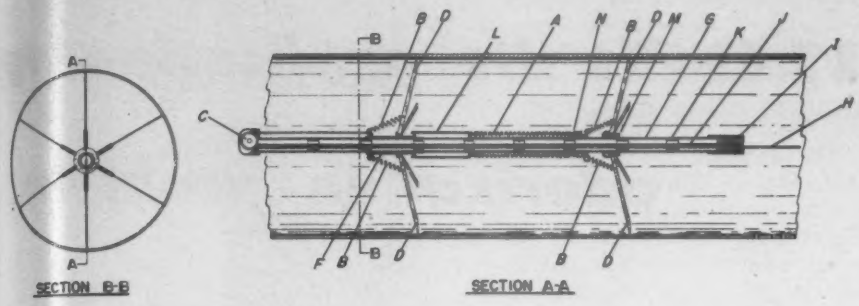


FIGURE 4



Design of crawler. (How it works explained in text).

ment of knuckle joints as shown in the center of the figure, and will traverse the 45-deg bend without difficulty.

After the crawler is in place in the line, it is moved forward by manipulation of the cable. The crawler is moved to the retrieving tube and is caught by the retrieving rod and pulled into the retrieving tube. The tap gate is closed and the packer removed. The crawler is pulled from the line, removed, and the microphone attached to the cable.

The microphone is placed in the retrieving tube with the microphone wire run through a packer. The tap valve is opened and the microphone is ready to be moved through the line for the leakage survey. The microphone cable is marked so the distance from the tap to the microphone head is known. Upon the completion of the survey, the microphone is retrieved, removed, and the pull cord retrieved. Valve savers are installed in the taps and the survey is complete.

Field Testing

Field tests were made in Houston. The first line selected was a 4⅝-in. OD welded line carrying a pressure of 14 psig. The survey covered approximately 800 feet and two leaks were found. Neither leak was known to exist, and there was no indication on the surface that a leak existed. The measurement was accurate, and in each instance, the leak was in the bell hole dug. At this pressure, the leak noise level was about six times higher than the background noise. The leak noise would start to build up approximately 10 ft from the leak and continue to rise to the highest level when the microphone was in the immediate vicinity of the leak. Immediately upon passing the vicinity of the leak the noise would drop to the background level.

The second survey was run on a 4⅝-in. OD line carrying 23 psig pressure. No leaks were found; however, a service tap was loosened to simulate a small leak. The response was satisfactory, although the peak noise level was only about twice the background noise level. This spread is sufficient to locate leaks and indicates that it is possible to find leaks in a buried line at higher pressures than in lines that are above ground and are not insulated by the earth.

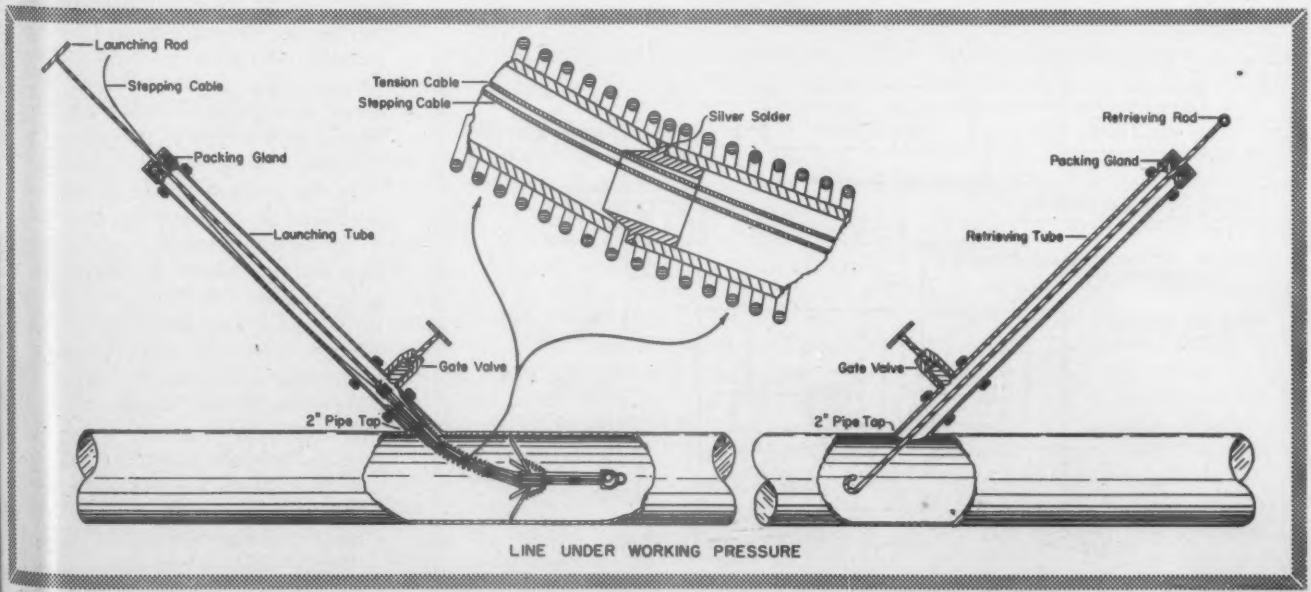
The third test was run on a 4⅝-in. OD line with a pressure of 3.703 ounces. There were no leaks found; however, as in the previous test, leaks were simulated by loosening service taps to create small leaks. Two such leaks were made and each was found. The noise level at this pressure was three or four times the background noise. At this pressure it was necessary to change the filter setting to a very low value and the characteristic of the leak was a low hiss. It was noted that the sound level break was not as sharp when the leak was passed as in the higher pressure lines; however, the signal is adequate to accurately locate leaks.

Summary

In conclusion, the sonic method has proved to be useful for finding the exact location of leaks in gas mains. With equipment that has already been field tested, 1000 ft of gas main can be surveyed for leakage by making only two taps. In most systems, leaks of all sizes can be readily and accurately located so that an excavation of only the size needed to repair the leak need be made.

Acknowledgment

This article was developed from a talk given at the AGA Distribution Conference, Houston, 1957. * * *



Special 45° tapping machine and system used for launching and receiving the crawler.

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The TITRILOG: Its application to odorization problems

D. McA. Mason
Institute of Gas Technology
Chicago, Illinois

BECAUSE of the problems involved in gas odorization, a need was created for an instrument that can continuously indicate and record the concentration of odorant in gas. The *Titrilog*, an instrument manufactured by Consolidated Electrodynamics Corporation, is at present the only instrument available for this job.

The Titrilog is used by utility gas companies principally for monitoring the concentration of odorant in natural gas. The usual specification is that the gas must be detectable in air before its concentration reaches 20 percent of the lower explosive limit. Thus, odor tests must be used to determine the amount of a particular odorizing material required for adequate odorization.

Use of odor tests on a routine basis, however, is handicapped by difficulties such as odor fatigue and variability of individuals. Laboratory chemical analysis is perhaps less difficult and more quantitative than odor testing, but one or several lab analyses per day cannot compare in usefulness with an instrument giving instantaneous readings and a permanent record, 24 hours a day.

The Titrilog provides, first of all, a means for assuring that the proper amount of odorant is put into the gas at all times, and provides a record of the fact. It can be used to prevent overodorization, with waste of an expensive material and increase in unwarranted service calls. It provides a challenge to the operator of odorizing equipment, calling for alertness in maintaining the proper level.

In portable form, or with transported samples, it can be used to determine whether the odorant level is maintained in all parts of the distribution system and under all conditions. Other uses which have been reported include checking for sulfur contaminants in natural gas, such as hydrogen sulfide and naturally-occurring mercaptans, and evaluating the design of odorizing equipment.

How It Works

Basis of this instrument is the reaction of bromine with the compound to be determined. The bromine is generated by passage of electric current through an electrolyte containing a bromide salt. Such electrical generation of titration reagents, where the amount of reagent is determined by measurement of the current, and Faraday's principle, is called coulometry and is one of the techniques of analytical chemistry that has been receiving increased attention in the last few years.

In the Titrilog, the sample gas is continuously passed through the electrolyte, and bromine is continuously generated in quantity just sufficient to react with the bromine-reactive compounds in the gas.

A schematic diagram of the instrument is shown in Fig. 1. The electrolyte in the cell is an aqueous sulfuric acid-potassium bromide solution. The sample gas, mixed with purified air, is introduced through a sintered glass bubbler below the surface of the electrolyte in the inner titration compartment. This compartment also contains two platinum electrodes, one for generation of bromine, and the other for sensing the presence and concentration of bromine.

The bromine-generating circuit is completed with a platinum electrode, outside the titration compartment. During the operation, the gas flowing through the compartment consists of purified air and sample during sampling periods, and only purified air during nonsampling periods when a "zero level" is established. A set low concentration of bromine is maintained in the titration compartment at all times.

In the instrument circuit the voltage produced by the sensing electrodes is in series with and opposed by a reference voltage which is nearly, but not quite, equal to it. The small difference in voltage is amplified to give a direct current, which is passed through the generating electrodes to produce bromine in the titration compartment. During nonsampling or "zero level" periods, bromine generation is required only to replace that lost by vaporization into the gas stream, and that removed by the carbon purifier in the cell.

When sample gas containing bromine-reactive compounds is admitted, the bromine concentration tends to fall,

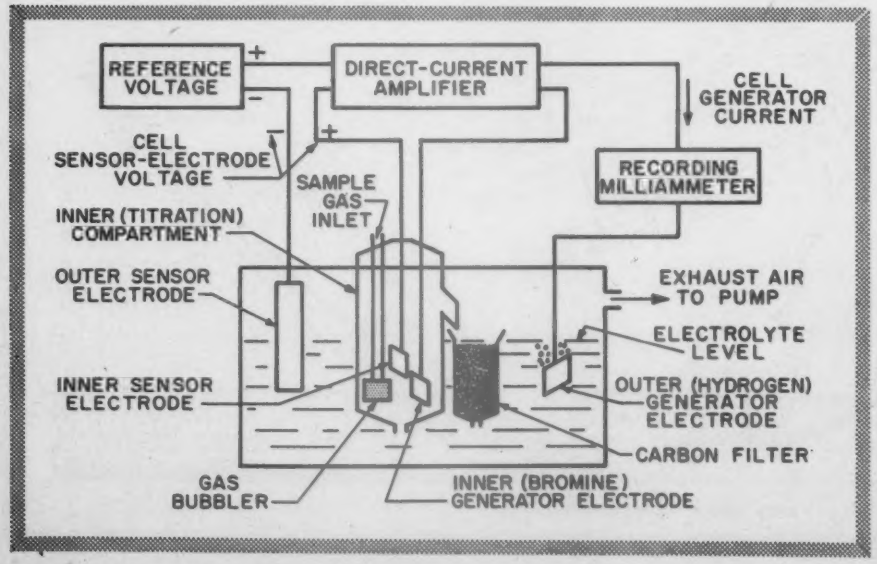

FIG. 1. Schematic diagram of cell and amplifier.

FIG. 2. Titrilog unit of the stationary type, installed at the Institute of Gas Technology.

and the difference between the reference voltage and the sensor electrode voltage increases, causing the amplifier output current to increase sufficiently to keep the bromine concentration nearly constant.

Thus, the principle of feedback is used to control continuously a wide range of bromine addition with only a small change in bromine concentration. The amplifier output current is recorded as the measure of the bromine titrant, and hence of the bromine-reactive constituents of the sample.

Titration

The majority of organic sulfur compounds, as well as sulfur dioxide and hydrogen sulfide, titrate in the Titrilog. Organic sulfur compounds that titrate include mercaptans, alkyl sulfides, alkyl disulfides and thiophenes. All of the commercial odorants titrate.

Carbon disulfide and carbonyl sulfide do not titrate or interfere. Gases such as carbon monoxide, carbon dioxide, hydrogen chloride, nitrogen, hydrogen, oxygen, and paraffinic hydrocarbons do not interfere.

Olefins and diolefins titrate with an efficiency of only one to two percent of the theoretical, and thus interfere only if present in quantities that are large in relation to the sulfur compounds.

The sensitivity of the instrument varies from one titratable compound to the next. The percentage of the compound which is absorbed and reacts may differ, as well as the mole ratio of bromine to the portion of compound that does react. Thus, Austin[1] found that the number of equivalents of bromine per mole of sulfur dioxide is very close to the theoretical value of two. In the case of butyl mercaptan, on the other hand, only about two-thirds is removed from the gas stream, and the titrant/compound ratio is 3.4 equivalents per mole. The sensitivity also varies somewhat from one instrument to the next, and from time to time on the same instrument.

Approximate values for the sensitivity of a typical instrument to a number of sulfur compounds that occur in commercial odorants are given in Table 1. These values apply to operation with highest sensitivity. The range of the instrument under these conditions is from 50 to 100 times the values listed. However, the range can be extended by a factor of three by a flip of a switch to change the range of the milliammeter. In addition, the range can be extended to still higher concentrations by reduction of the rate of sample flow.

TABLE 1. TITRILOG SENSITIVITY
For sample Flow of 700 ml/min

	S Compound Per Chart Division*	
	Grain S/100 cu ft	Lb/ MMcf
Hydrogen sulfide	0.004	—
Methyl mercaptan	0.003	0.007
Ethyl mercaptan	0.005	0.015
Butyl mercaptan	0.008	0.031
Dimethyl sulfide	0.013	0.036
Methyl disulfide	0.006	0.012
Tetrahydrothiophene	0.011	0.042

*Full-scale = 100 divisions.

The instrument is available in both stationary and portable models (Fig. 2 and 3). It is furnished with means for automatic cycling from one sample stream to another, so four different sample sources can be tested, one after the other, in addition to the zero level determination. A fifteen-minute period is normally used. A portion of a chart obtained in the analysis of two streams is shown in Fig. 4.

Alternatively, the automatic cycling sample system may be set up to analyze for types of sulfur compounds. One or more of the four sample lines can be furnished with absorbers for removing one or more types of sulfur compounds. An absorber solution is available for removing hydrogen sulfide only, and another for removing both hydrogen sulfide and mercaptan.

By first running the sample directly, then with each of the two absorbing solutions, one may obtain readings for hydrogen sulfide, mercaptans, and residual sulfur compounds consisting usually of sulfides and/or disulfides. The readings for mercaptan and residual sulfur can be translated into the amount of each, if the identity of the sulfur compound is known or can be established.

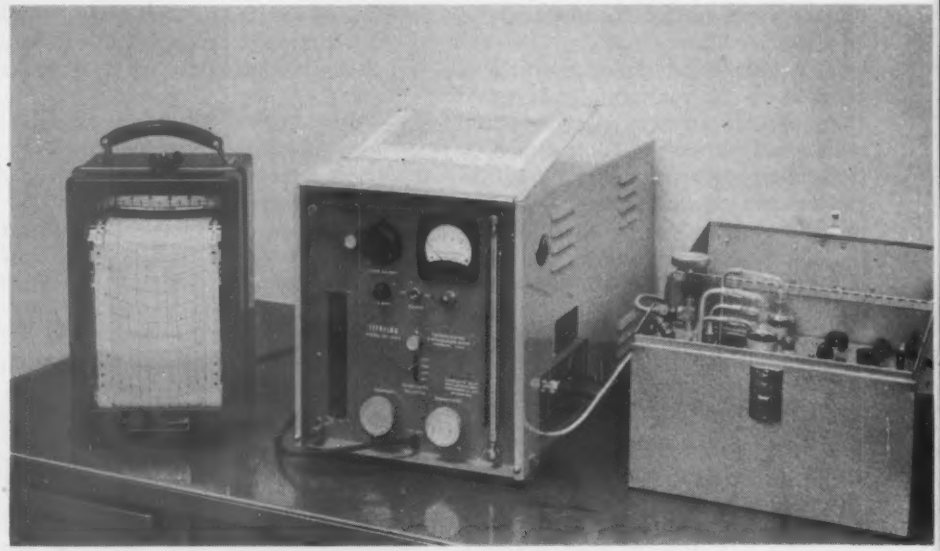

FIG. 3. Portable Titrilog unit can be carried to field.

Calibration

Since the sensitivity of the instrument does not remain constant, it is necessary to calibrate periodically with a gas sample containing a known amount of sulfur compound. The manufacturer recommends calibrating with a blend of hydrogen sulfide in methane when hydrogen sulfide is to be determined, and with a blend of butyl mercaptan in methane when organic sulfur componds or odorants are to be determined. These calibration blends are furnished by the manufacturer in stain-

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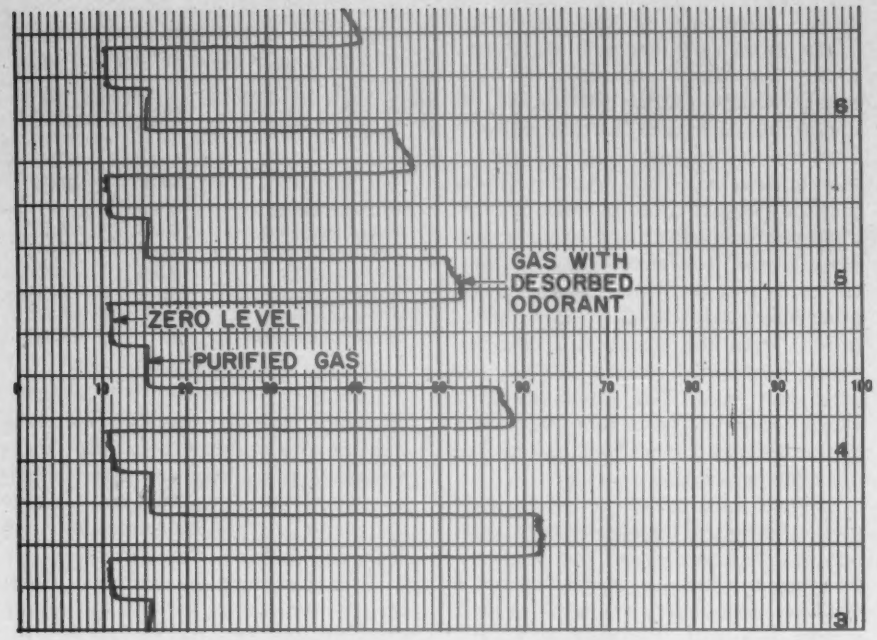

FIG. 4. Titrilog record of repetitive analysis for odorant in two different gas streams.

less steel tanks. "Compound factors" are supplied with the instrument to relate the response to butyl mercaptan to that of other sulfur compounds and odorants.

The compound factor, which is claimed to be substantially constant from one instrument to another, is used with a cell constant K (determined by calibration with the blend of known concentration), and sample flow rate in the formula:

$$\text{Concentration of sulfur compound} = \left(\begin{matrix}\text{Instrument}\\ \text{reading}\end{matrix}\right) \times \frac{\text{compound factor}}{(\text{flow}) \qquad (\text{K})}$$

Maintenance

Preventive and routine maintenance of the instrument requires about one day's work per month. Both for this work and for trouble shooting, familiarity of personnel with glass apparatus and chemical principles is of more importance than familiarity with electronics. With our instrument we have experienced a rate of downtime of five to ten percent.

Experience and correctives that may be of interest to others include:

1) Leakage of electrolyte past the platinum-in-glass seal in both of the two cells we have used, requiring services of a glass-blower.
2) Instability of the zero reading, due to impurities in the room air. (This was corrected by a ten-fold increase in the size of the active carbon-soda lime purifier.)
3) Spoilage of the electrolyte if the vacuum pump fails during a period when the instrument is unattended. (We have added a vacuum-actuated relay to turn off the instrument and prevent continued generation of bromine when pump failure occurs.)

Sample Handling

Loss of sulfur compound when sample gas is retained in a sample container, or when it is passed through connecting lines, is a frequent source of difficulty in use of the Titrilog as well as with other methods of analysis. Such difficulties appear to be due to: Reactivity toward oxygen in the case of hydrogen sulfide and mercaptans; reactivity toward metals in the case of hydrogen sulfide and perhaps also mercaptans; and high adsorptiveness of organic sulfur compounds on polar surfaces.

On silica gel, for example, mercaptans, alkyl sulfides and thiophenes are adsorbed more strongly than saturated hydrocarbons, olefins or alkyl benzenes. Since the amount of sulfur compound is usually only in the order of ten parts per million, and the ratio of sulfur compound to container is in the order of less than one part per million, it is obvious that trouble can result from very small amounts of oxygen in the sample or adsorbed on the walls of the container, or from a very small amount of adsorptive activity on the part of the container walls.

Our experience with storage of oil gas in small (10 cu ft) steel water-sealed gas holders may be cited as an extreme example of such difficulties; several hundred grains of hydrogen sulfide per 100 cu ft may disappear completely from the sample on standing overnight, while 90 percent or more of the organic sulfur may be lost.

Stainless steel containers, notably the cheap and convenient 1.2 cu ft oxygen breathing tanks, are often used with better results; however, a slow decline in sulfur content over several months time has often been noted during the storage of samples containing either hydrogen sulfide or mercaptan. This behavior is particularly distressing when encountered with standard samples used for calibrating the Titrilog over an extended period of time.

We have made a few tests on the use of aluminum containers in the form of 31 gal beer barrels and bilge-type shipping drums, which can be used at pressures up to 60 psi. Since we were mainly interested in naturally-occurring sulfur compounds, the tests were made with hydrogen sulfide and methyl mercaptan.

Results may be summarized:

1) An initial period of rapid loss of both hydrogen sulfide and methyl mercaptan was observed in several tests.
2) In one case a test with both hydrogen sulfide and methyl mercaptan present was continued for 6½ months. During the last five months of this test, both the hydrogen sulfide and mercaptan content appeared to be stable at approximately 1.5 gr S per 100 std cu ft within the accuracy of the test, or within about ± 0.1 gr S per 100 std cu ft.
3) After the above test, air was added to the container in an amount approximately equal to that required for oxidizing the hydrogen sulfide to sulfur, and the mercaptan to disulfide. Both hydrogen sulfide and mercaptan content then dropped to less than 20 percent of the previously stabilized value.

Additional testing with odorant compounds would be required to determine the suitability of these barrels as containers for calibration standards.

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Acknowledgment

This article prepared from a presentation made at the 1957 AGA Chemical, Engineering, and Manufactured Gas Production Conference, Bal Harbour, Florida. * * *

Economic and Engineering Evaluations Of Alternate Methods for MEETING PEAK DEMANDS

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UNFORTUNATELY it is impossible to arrive at the solution of peak-demand problems by gazing into a crystal ball. The gas supply engineer's solutions must be based upon an informed background of factual knowledge of what has been done in the past, what is being done today and what should be done in the future.

If experience is truly the best teacher, it should be of value to examine some of the essential and proved facts regarding the industry-wide challenge of meeting peak-load demands economically.

Source of such data can be found in studies made for a number of years by the Southern California Gas Company, Southern Counties Gas Company of California and outside help. These studies were made to obtain some indication of the fixed charges and operating expenses associated with gas transmission and storage.

One of the results of these studies is usable data for making cost estimates for preliminary economic and engineering evaluations for meeting peak demands. These findings have been consolidated into the following report which is devoted to the graphic presentation of capital, manual and unit costs of additional primary gas supply, above ground holders and underground storage. Generally focusing on costs, it also briefly describes technological functions.

The types of load equation methods included in this study, all of which are in common use in industry, are as follows:

Additional primary supply
High and low pressure above ground holders
Underground storage

Other types now in use or in the pilot plant stage were considered but not included in this report. They are:

Pipeline pack and draft
High Btu oil gas
Propane-air-natural gas
Pipe batteries
Natural gas storage by liquefaction
Natural gas storage in high pressure bottles
Natural gas storage by adsorption on Fuller's earth
Propane-air mixture from propane stored in mined caverns
Catalytic cracking of castinghead gasoline or propane
Pyrolytic cracking of the TPC or the fluidized coking process

Additional primary supply may provide seasonal load equation and, at times, hourly load equation too. Capital costs of facilities with capacities of 400 MMcf per day or more average about $25 per 100 miles for each Mcf of daily capacity. Operated at 100 percent load factor, the unit annual costs of such facilities are about 1.1¢ per 100 miles for each Mcf transported.

Low pressure above ground holders provide hourly load equation. They generally range in size from several hundred thousand to 15 MMcf. A large utility might have groups of holders totaling well over 100 MMcf of volumetric capacity. Capital costs of holder stations of 8 to 10 MMcf rated capacity average about $400 for each Mcf of daily capacity. Since these computations are based on one cycle per day, this is also $400 per Mcf of volumetric capacity. On a one fill and withdrawal per day basis, the unit annual cost of such facilities is about $1.05 per Mcf, covering all items, including maintenance, and recompression to operating pressure.

High pressure above ground holders are generally used for "pin-point" peaking. They range in size from about 50,000 to 500,000 cu ft. Capital costs of installations of one million cubic feet per day or more average about $440 for each Mcf of daily capacity. Since these computations are based on one cycle per day, this is also $440 per Mcf of volumetric capacity. On the basis of one complete cycle each day, the unit annual costs are about 7¢ per Mcf, including all costs.

Underground storage is used for seasonal, week-day, weekend and hourly load equation. Volumetric working capacities vary from .5 to 90 billions of cubic feet; withdrawal rates range from 50 MMcf to 500 MMcf per day. Capital costs of facilities with capacities of 400 million cubic feet per day or more average about $40 for each Mcf of daily capacity. Unit annual costs generally range from 10 to 20¢ per Mcf.

In summary, each method has its place in respect to capacity and function to be performed:

Daily capacities, cu ft per day	
High pressure holder:	50 to 500 Mcf
Low pressure holder:	500 Mcf to 15 MMcf
Underground storage:	50 MMcf to 500 MMcf
Additional primary supply:	300 MMcf to 1-billion cu ft

Certain average capital requirements and unit costs are associated with each method:

	$/Mcf	¢/Mcf
High pressure holders (100% L.F.)	440	7
Low pressure holders (100% L.F.)	400	105
Underground storage	40	15
Additional primary supply (per 100 miles of pipeline)	25	1

General assumptions applicable to all methods:

1) Price and wage levels adjusted to 1956 by use of the Handy-Whitman Index of Public Utility Construction Costs — Pacific Division. See Fig. 1.
2) Generally accepted good operating practice.
3) All volumes at 14.73 psia, 60 F.
4) Estimated fixed charges are based on (a) return on plant investment at 6 percent, (b) Federal taxes on income at 52 percent, (c) State franchise taxes on income at 4 percent, (d) Ad valorem taxes at 2.55 percent of the capital investment.

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Additional primary supply for load equation: Several hypothetical cases were studied together with a number of actual cases.

Assumptions applicable to all hypothetical cases:

1. Typical construction and operating conditions in southwestern United States.
2. No pipeline to exceed 30 in. in diameter.
3. All compressors to be reciprocating.
4. Wall thickness of each pipeline constant rather than tapered.
5. Interest during construction at 4 percent per year for money actually in project.
6. Depreciation reserve equal to 13 percent of the historical cost of transmission and general facilities.
7. Working capital 1.52 percent of the historical cost of each project.
8. Capacity used 100 percent for transport; i.e., no line pack and draft.

Assumptions applicable to hypothetical cases 1 through 3 are tabulated in Tables 1 through 6.

Added primary supply is ideally suited for the seasonal equation of firm load when it can all be sold to interruptible customers at a profit during the summer months. To a limited degree, even if the sale of the summer surplus results in a revenue deficiency, the deficiency will be less than that resulting from a lower load factor. Finally, cut back and lower load factor are practical to the extent that additional primary supply is cheaper than any other method.

To the extent that there is excess storage capacity for the gas elsewhere in the system during off-peak hours, hourly load equation may also be provided without additional expense due to fixed charges. Otherwise, in order to obtain hourly load equation, additional capital will be required to provide line pack storage. This capital is not included in the capital requirements presented in this report.

Pipeline systems transporting additional primary supply hundreds of miles are low in capital requirements and annual costs providing the throughput exceeds 100 MMcf per day.

The capital requirements of the pipeline systems in the three hypothetical cases and in a number of actual cases were related to deliverability. The band-like graphs in Fig. 2 and 3 take in all of the data.

Annual costs were similarly correlated at various load factors. The results are shown in Fig. 4 and 5.

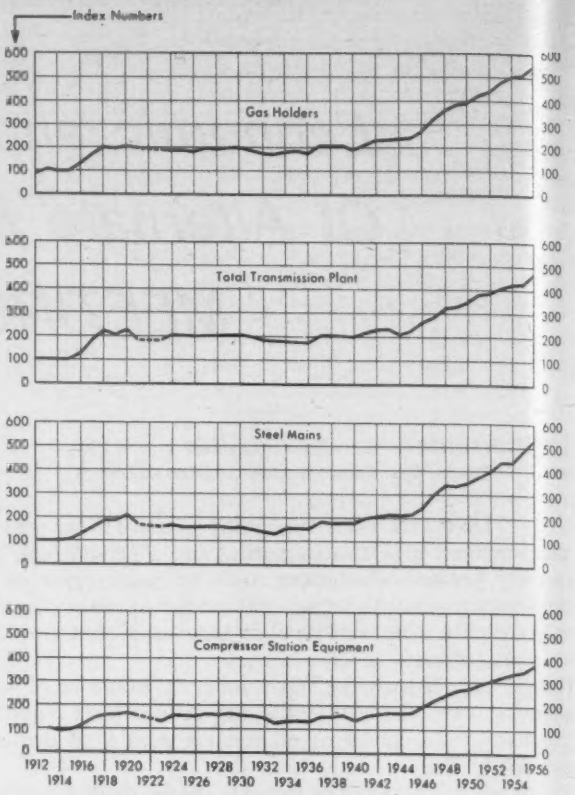

FIG. 1. Cost trends of gas plant construction.

Low pressure holders for hourly load equation: Low pressure above ground holders are used primarily for hourly load equation. This is shown graphically in Fig. 6. There are two types, water sealed and waterless.

Capital requirements for low pressure holders and holder stations were correlated with rated capacity. And the range of the results is shown in Fig. 7 and 8. Annual costs for holders and stations were similarly correlated, and the results are given in Fig. 8 and 9. Annual costs were also related to gross withdrawal and the results shown in Fig. 10 and 11.

Economic and regulatory considerations are limiting factors of prime importance in respect to volumetric capacity and de-

TABLE 1. Specified Operating Conditions for Hypothetical Pipeline Case I.

	A	B	C	D	E
1. System Number	1	2	3	4	5
2. Peak-day throughput (MMcf/day at 14.73 p. b.)	1.01154	10.1154	101.154	505.77	1,011.54
3. Annual Load Factor	25	25	25	25	25
	50	50	50	50	50
	75	75	75	75	75
	100	100	100	100	100
4. Transmission distance (Miles)	500	500	500	500	500
5. Pressure at pipeline intake (psig)	500	500	500	500	500
6. Pressure at pipeline discharge (psig)	500	500	500	500	500

TABLE 3. Specified Operating Conditions for Hypothetical Pipeline Case II.

	A System 1	B System 2	C System 3	D System 4
1. Peak-day throughput (14.73 psia p. b.) (Mcf)	54,503	138,165	286,382	1,275,481
2. Annual throughput (14.73 psia p. b.) (Mcf)	16,845,081	31,182,224	73,669,017	465,550,730
3. Annual load factor (%)	84.8	63.0	73.0	100.0
4. Transmission distance (Miles)	95	262	577	705
5. Pressure at pipeline intake (psig)	500	500	500	500
6. Pressure at pipeline dsicharge (psig)	250	250	250	500

TABLE 2. Design Summary for Hypothetical Pipeline Case I.

	A System 1	B System 2	C System 3	D System 4	E System 5 (looped line)
1. A. Maximum Day Delivery (M Mscfd at 14.73 psia base)	1.01154	10.1154	101.154	505.77	1,011.54
2. B. Pipe, Size, Wall and Specification	3" std. 5L	8" x ¼" 5L	18" x ¼" X42	30" x ⅜" X52	30" x ⅜" X52
3. C. Maximum Station Discharge Pressure Used, psia	1,155	950	855	951	951
D. Initial Station					
4. 1. Size of units	50 hnp	400 hp	1,200 hp	2,500 hp	2,500 hp
5. 2. No. of units instlled	2	2	4	8	15
6. 3. Installed brake horsepower	100	800	4,800	20,000	37,000
7. 4. Operating brake horsepower	45	331	2,730	16,700	33,400
E. Typical Stations					
8. 1. No. of typical stations		1	2	3	3
9. 2. Size of units in typical stations		100 hp	1,200 hp	2,500 hp	2,500 hp
10. 3. No. of units installed in each station		2	3	5	9
11. 4. Installed brake horsepower in each typical station		200	3,600	12,500	22,500
12. 5. Operating brake horsepower in each typical station		92	2,310	9,350	16,700
F. System Totals					
13. 1. Total number of stations	1	2	3	4	4
14. 2. Total number of units installed	2	4	10	23	42
15. 3. Total installed brake horsepower	100	1,000	12,000	57,500	105,000
16. 4. Total operating brake horsepower	45	423	7,350	44,750	89,500

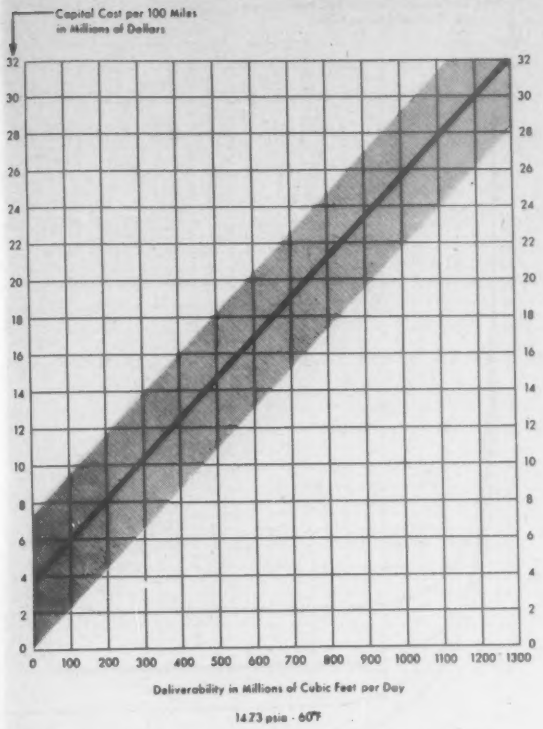

FIG. 2. Capital cost per 100 miles of pipeline deliverability.

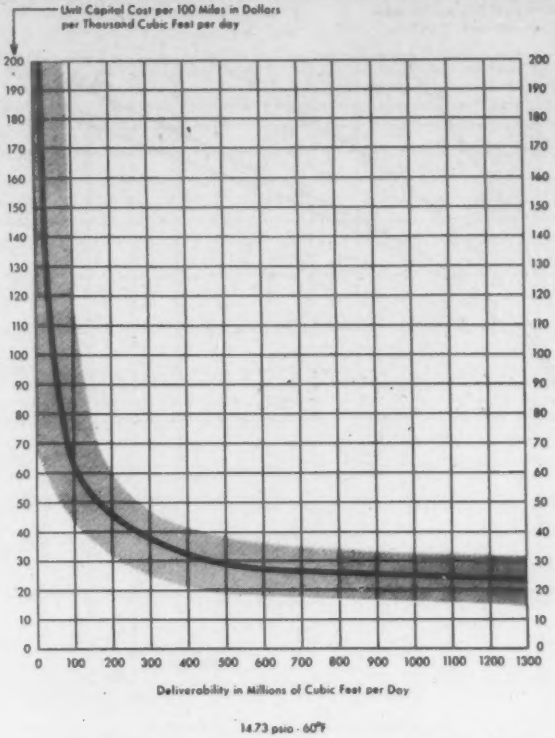
Unit Capital Cost per 100 Miles in Dollars per Thousand Cubic Feet per day
Deliverability in Millions of Cubic Feet per Day
14.73 psia - 60°F

FIG. 3. Unit capital cost per 100 miles of pipeline deliverability.

TABLE 4. Design Summary for Hypothetical Pipeline Case II.

	A System 6	B System 7	C System 8	D System9
1. A. Maximum Day Delivery (MMscfd at 14.73 psia base)	54.5	138.2	286.4	1,275.5
2. B. Pipe Size, Wall and Specification	12¾ x ¼ Grade B	20 x ¼ X52	26 x 5/16 X52	30 x 3/8 X52
3. C. Maximum Station Discharge Pressure used, psia	725	896	915	951
D. Initial Station				
4. 1. Size of Units	500	2,000	2,200	3,300
5. 2. No. of units installed	3	3	5	14
6. 3. Installed brake horsepower	1,500	6,000	11,000	46,200
7. 4. Operation brake horsepower	1,010	4,080	8,780	43,500
E. Typical Stations				
8. 1. No. of typical stations	none	none	2	8
9. 2. Size of units in typical stations	—	—	2,000	3,300
10. 3. No. of units installed in each station	—	—	4	9
11. 4. Installed brake horsepower in each typical station	—	—	8,000	29,700
12. 5. Operating brake horsepower in each typical station	—	—	5,020	25,900
F. System Totals				
13. 1. Total number of stations	1	1	3	9
14. 2. Total number of units installed	3	3	13	86
15. 3. Total installed brake horsepower	1,500	6,000	27,000	283,800
16. 4. Total operating brake horsepower	1,010	4,080	20,020	250,700
17. G. Distance Gas Transmitted (miles)	95	262	577	705

TABLE 5. Specified Operating Conditions for Hypothetical Pipeline Case III.

	A	B	C	D	E	F	G	H
1. Year of Operation		1	2	3	4	5	6	7
2. Maximum daily capacity (M³cfd)		54.9	196.7	329.2	451.9	653.2	777.4	777.4
3. Line operating (days/year)		365	365	365	365	365	365	365
4. Load factor for new gas (percent)		100	100	99.6	98.7	88.3	88.3	100
5. Load factor for total gas (percent)		100	100	99.9	99.5	94.4	93.9	100
6. Total gas delivered/year (MMcf)		20,038.5	71,795.5	120,037.8	164,118.8	225,066.6	266,442.2	283,751.0
7. Transmission distance (miles)		215	215	215	215	215	215	215
8. Pressure at pipeline intake (psig)		500	500	500	500	500	500	500
9. Pressure at pipeline discharge (psig)		465	465	465	465	465	465	465

TABLE 6. Design Summary for Hypothetical Pipeline Case III.

	A	B	C	D	E	F	G	H
1. Year of Operation	0	1	2	3	4	5	6	7
2. Maximum daily capacity (MMcf)		54.9	196.7	329.2	451.9	653.2	777.4	777.4
3. Pipe size, wall and specification	30x	30x	30x	30x	30x	30x	30x	30x
4. Maximum station discharge pressure (psia)	940	940	940	940	940	940	940	940
Initial Station								
5. Size of units			2,000	2,000	2,000	2,000	2,000	2,000
6. No. of units installed			2	2	9	13	15	15
7. Installed brake horsepower			4,000	12,000	18,000	26,000	30,000	30,000
8. Operation brake horsepower			3,680	11,400	17,200	24,800	29,600	29,600
Typical Stations								
9. No. of typical stations				1	1	1	1	1
10. Size of units				2,000	2,000	2,000	2,000	2,000
11. No. of units installed in each station				5	5	5	5	5
12. Installed brake horsepower in each				10,000	10,000	10,000	10,000	10,000
13. Operating brake horsepower in each				9,800	9,800	9,800	9,800	9,800
System Totals								
14. Total number of stations			1	2	2	2	2	2
15. Total number of units installed			2	7	14	18	20	20
16. Total installed brake horsepower			4,000	22,000	28,000	36,000	40,000	40,000
17. Total operating brake horsepower			3,680	21,200	27,200	34,600	39,400	39,400
18. Distance gas transmitted (Miles)	215	215	215	215	215	215	215	215

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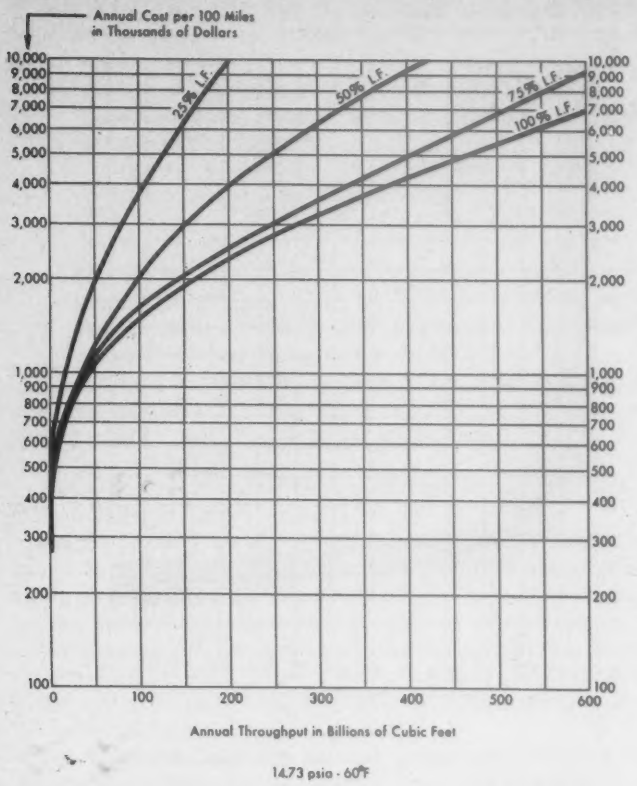
Annual Cost per 100 Miles in Thousands of Dollars
25% L.F.
50% L.F.
75% L.F.
100% L.F.
Annual Throughput in Billions of Cubic Feet
14.73 psia - 60°F

FIG. 4. Annual cost per 100 miles of pipeline annual throughput for various load factors.

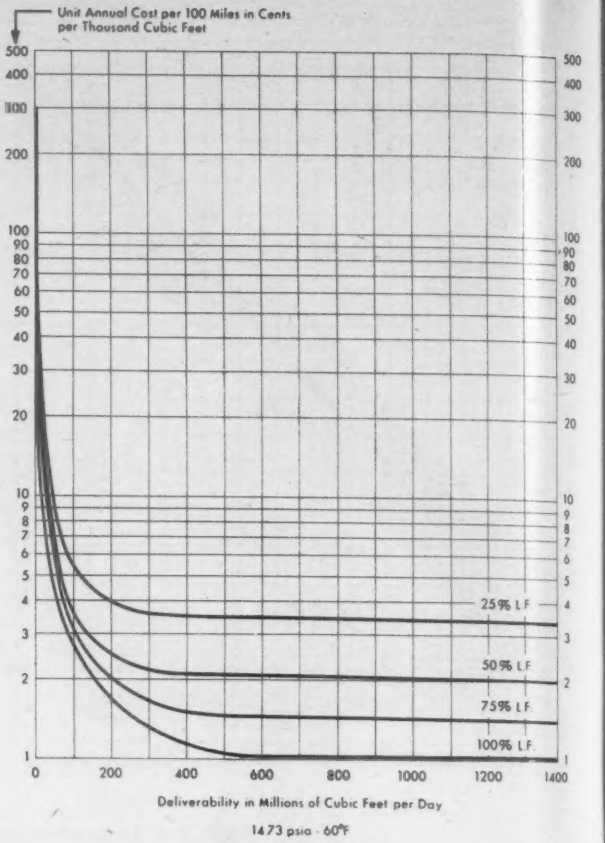
Unit Annual Cost per 100 Miles in Cents per Thousand Cubic Feet
25% L.F.
50% L.F.
75% L.F.
100% L.F.
Deliverability in Millions of Cubic Feet per Day
14.73 psia - 60°F

FIG. 5. Unit annual cost per 100 miles of pipeline deliverability for various load factors.

liverability. Normal volumetric capacity range is from several hundred thousand to 15 Mcf.

High pressure holders for "pin-point" peaking: High pressure above ground holders are use primarily for abnormal peak demands of short duration; in other words, "pin-point" peaking.

This is illustated in Fig. 12 and 13.

High pressure holders may be:

a) Cylindrical pressure vessels, installed horizontally or vertically.
b) Hortonspheres.
c) Spheres.

Structural and economic considerations are the limiting factors with regard to volumetric capacity and deliverability. Normal volumetric capacity range is from 50 Mcf to 500 Mcf; deliverability range is from 30 to 500 Mcf per hour.

The capital range requirements of high pressure holder stations were correlated with rated capacity. And the results are illustrated in Fig. 14 and 15. Annual costs were similarly treated and the results are shown in Fig. 16 and 17.

Specific operating conditions for hypothetical above ground holder stations are detailed in Table 7.

TABLE 7. Specified Operating Conditions for Hypothetical Above Ground Holder Installations.

Line	Column A High Pressure	Column B Low Pressure
1. Rated capacity (MMcf)	.555	10.0
2. Maximum usable cap (MMcf)	.505	9.469
3. Estimated usable for load equation (MMcf)	.25	8.0
4. Annual gross withdrawal (MMcf)		525
5. Maximum withdrawal rate (Mcf per hour)	100	1,150
6. Maximum fill rate (Mcf per hour)	100	2,000
7. Horsepower		3,300
8. Top pressures	55 Lb.	17" W.C.
9. Base pressures		5.3" W.C.
10. Installation in operation (days per yr)	365[1]	183
11. Installation inoperative (days per yr)	1	182

[1]Pressure settings would be lowered during summer operations.

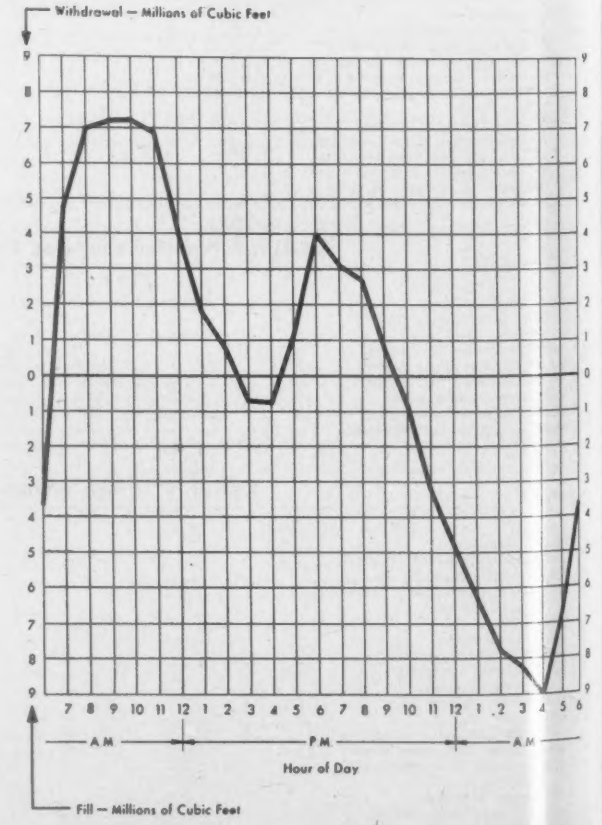

FIG. 6. Typical load equation provided by low pressure holder installation.

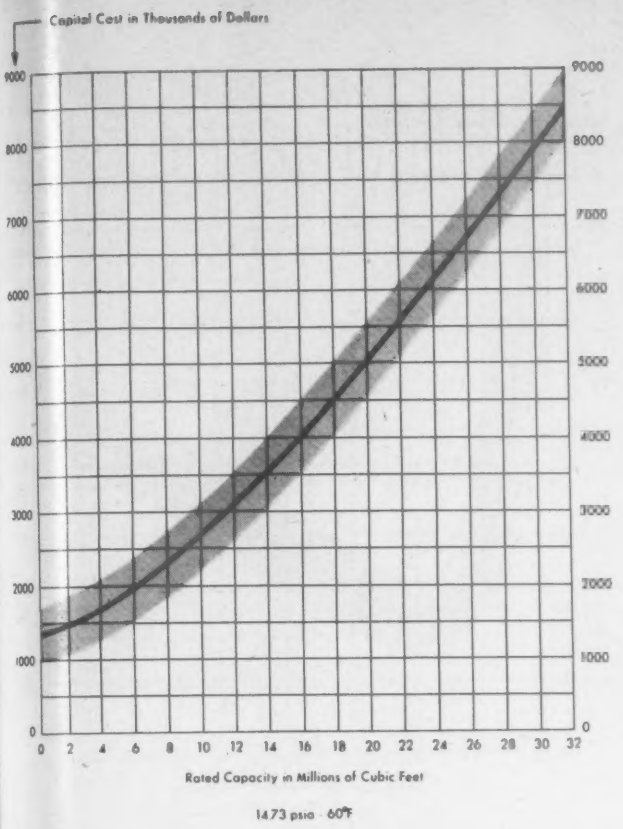

FIG. 7. Capital cost of low pressure holder rated capacity.

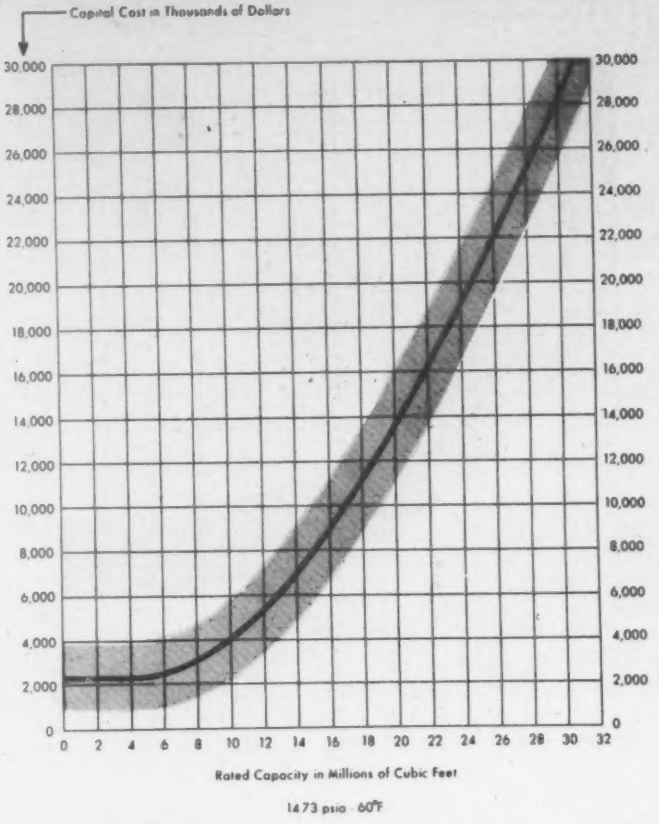

FIG. 8. Capital cost of low pressure holder station rated capacity.

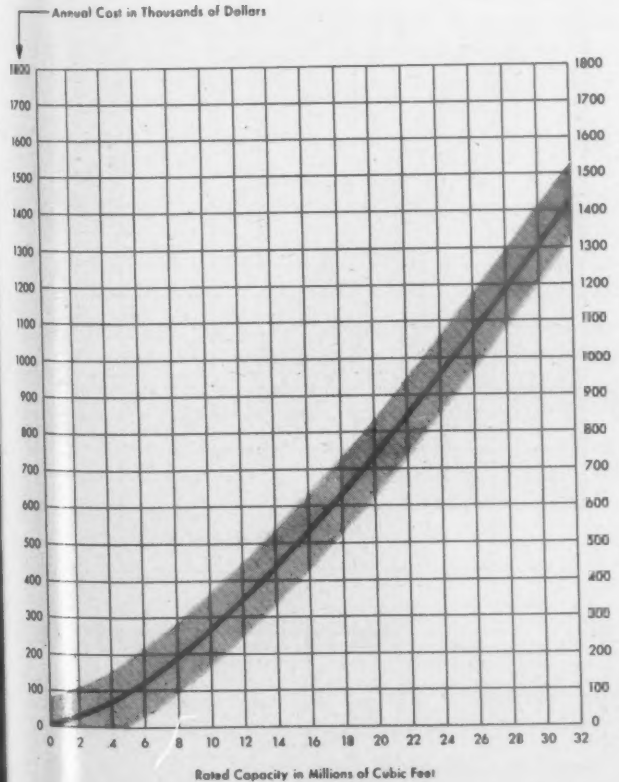

FIG. 9. Annual cost of low pressure holder station rated capacity.

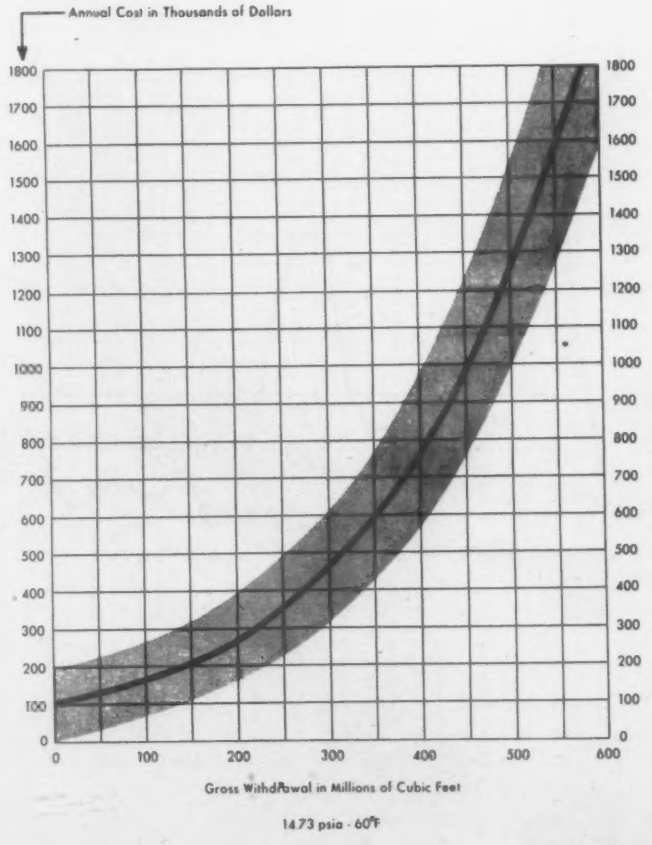

FIG. 10. Annual cost of low pressure holder station gross withdrawal.

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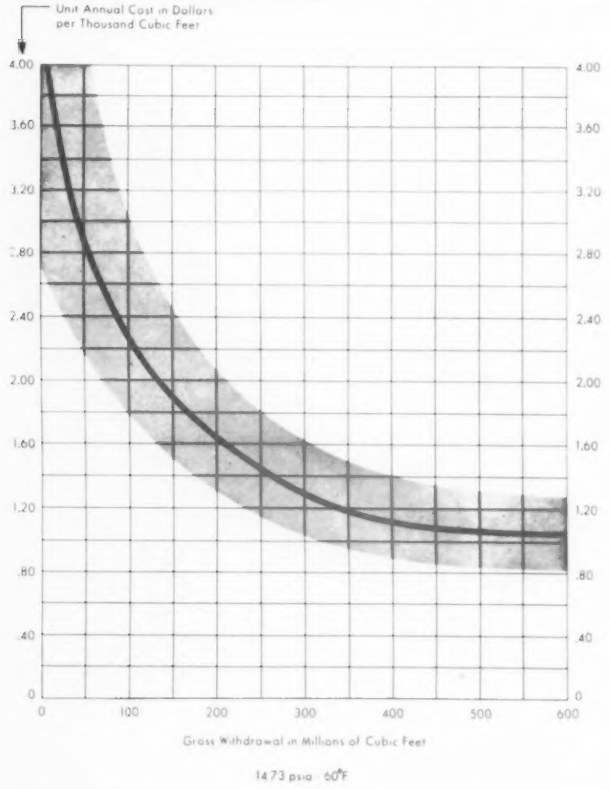
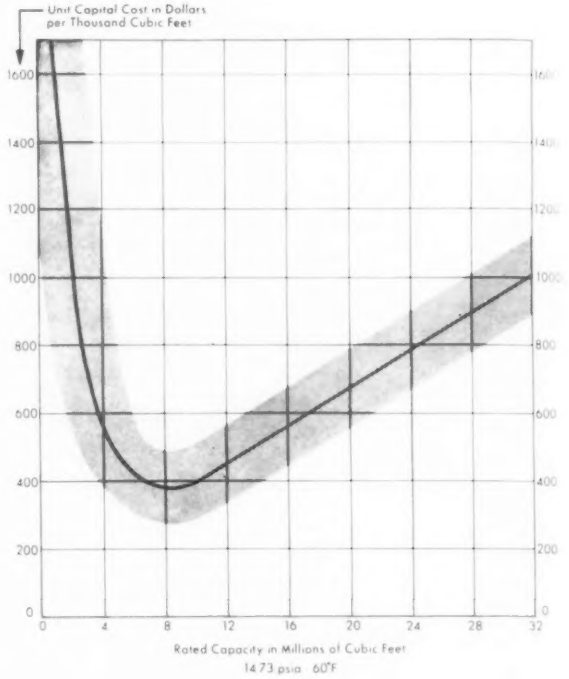


FIG. 11. Unit annual cost of low pressure holder station gross withdrawal.



Unit capital cost of low pressure holder station rated capacity.

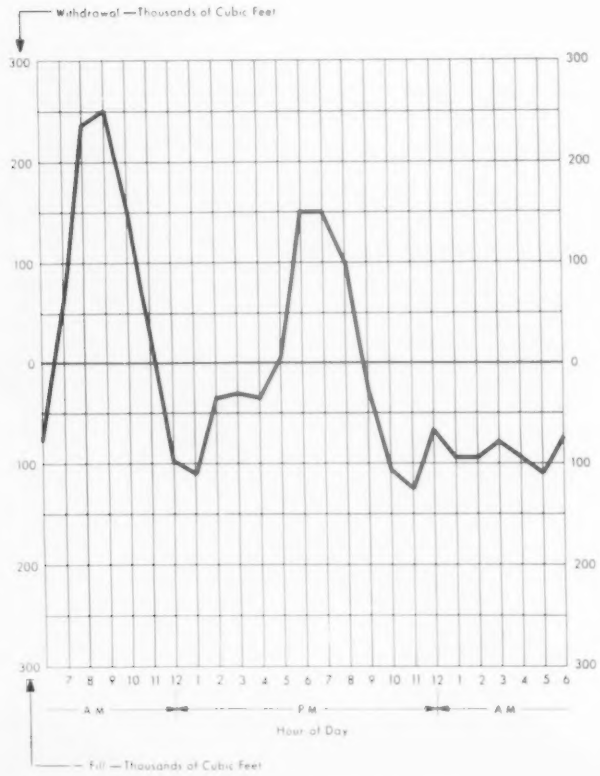


FIG. 12. Typical load equation provided by high pressure holder installation.

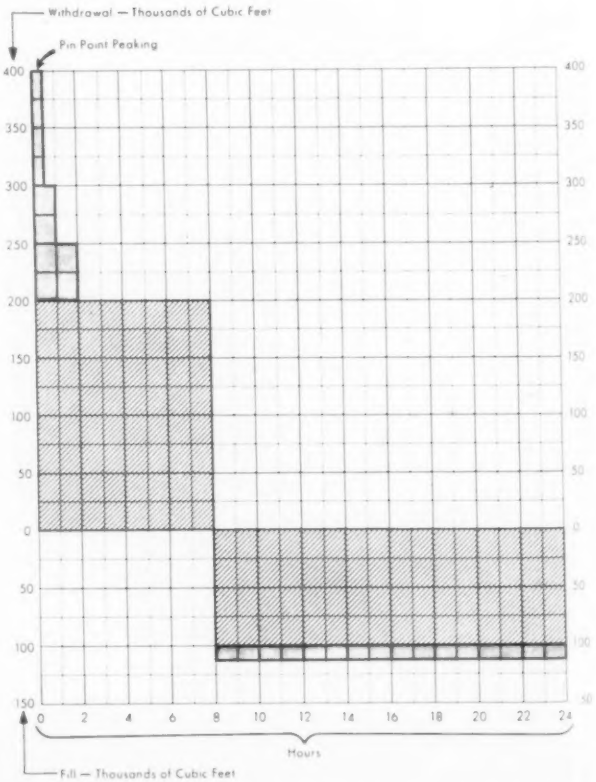


FIG. 13. Typical pin point peaking provided by high pressure holder installations.

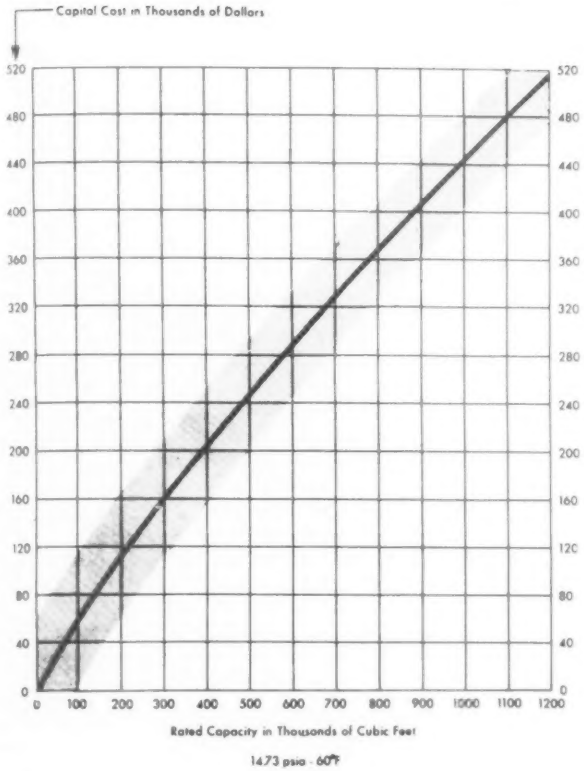


FIG. 14. Capital cost of high pressure holder station rated capacity.

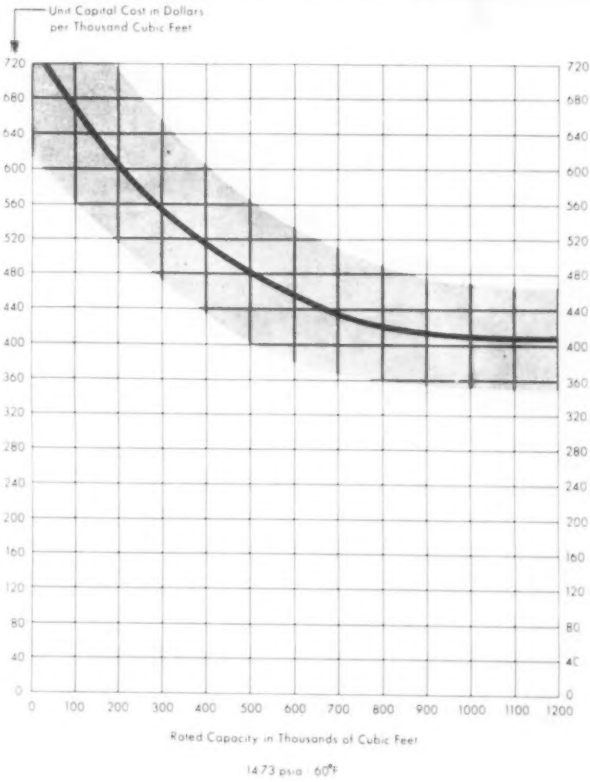


FIG. 15. Unit capital cost of high pressure holder station rated capacity.

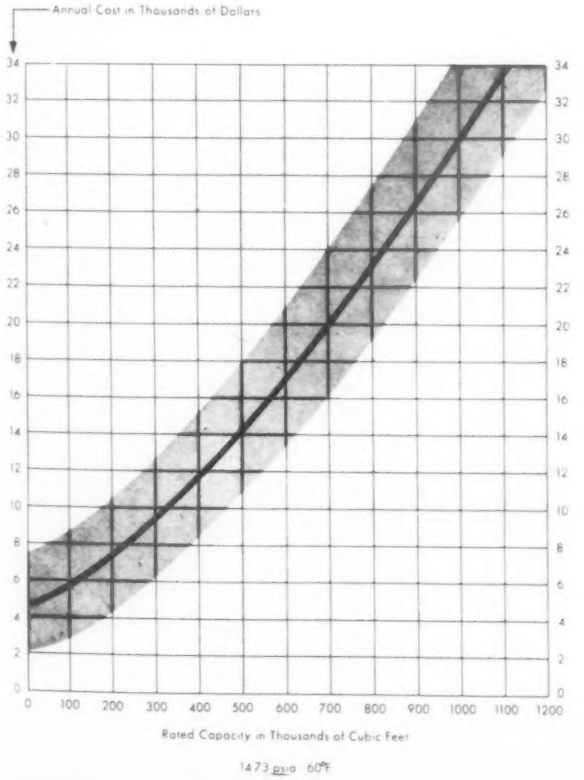


FIG. 16. Annual cost of high pressure holder station rated capacity.

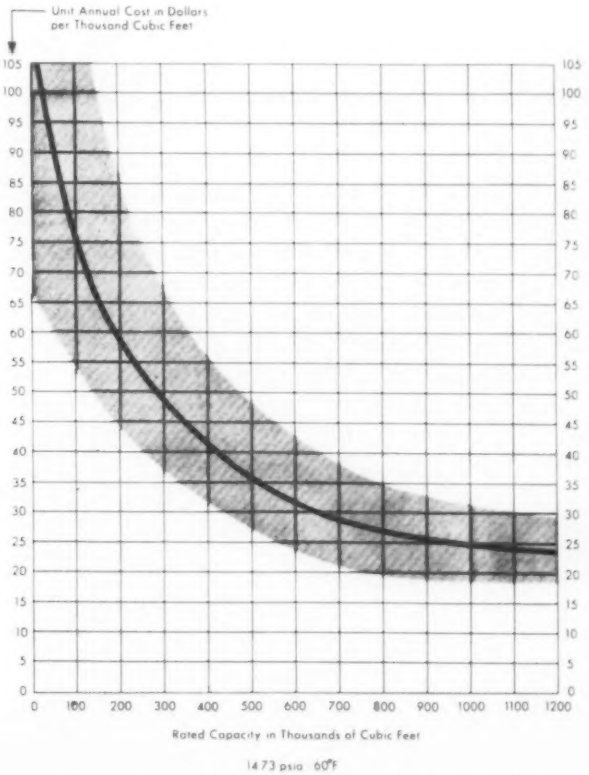


FIG. 17. Unit annual cost of high pressure holder station rated capacity.

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Underground Storage for seasonal, week-day, week-end and hourly load equation: Figures used for working volume are the net gas injected during the summer season and withdrawn during the winter season; in other words, they are consistent with the base and top pressures.

Comparison of annual and unit costs of other equation methods with cost of underground storage must be made on a gross withdrawal basis; otherwise, costs will be overstated if it is assumed that project is only operated at the working volume or a fraction thereof.

The cost data apply to underground storage only and not to related transmission facilities. But data for the latter are very important and must be considered. Obviously an underground storage reservoir in a metropolitan area is more valuable than one located in an area remote from the market.

Because of the many variables involved in underground storage, the ranges of capital requirements, annual costs and unit costs as functions of capacity (Mcf) and deliverability (Mcf per day) are wide. Some of the most important of these are discussed below.

1. *The historical status of a reservoir where gas is to be stored has an important bearing on costs:*

In some cases, storage is developed from abandoned oil and gas fields. And it is necessary to do a thorough job of reconditioning wells to be used for gas injection and withdrawal and abandoning wells not needed for the project. Fluids — oil and water — must be removed from depleted oil fields by conventional production methods and by recycling in order to obtain dependable deliverability and injectivity.

In other instances the storage possibilities are recognized before the reservoir is completely depleted and producing wells are converted to storage wells at a lesser cost than in the case of abandonment.

In still other cases, in addition to reconditioning, redrilling and abandonment, new wells must be drilled.

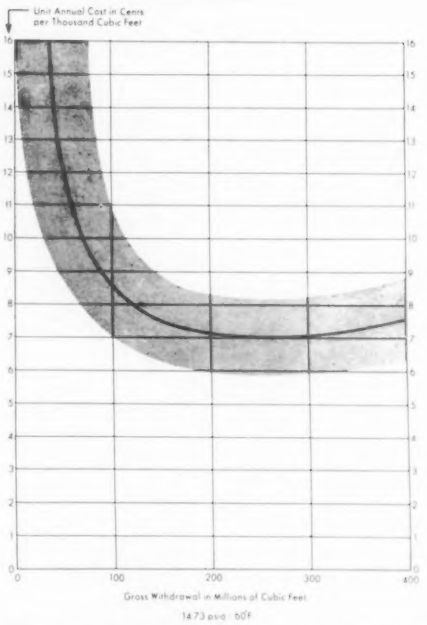
Complete records of oil and gas fields and water reservoirs are required to make possible, with minimum exploration, accurate estimates of requirements for conversion to storage and operating characteristics.

Some or all of the "additional" cushion gas; that is, gas in excess of the native gas, is required if conversion to storage is started with a reservoir pressure below the base pressure. Situations are known where the native gas is in excess of the total cushion gas by more than 60 billion cu ft, and others where over 50 billion cu ft of additional cushion gas was injected.

2. *Reservoir pressure is a significant factor in the cost of underground storage.* It influences the type of operation of the project. It and the transmission system pressures, which it must "buck," determine if compression is necessary. And if it is, whether it is needed for injection or for withdrawal, or both. An example of reservoir pressures is illustrated in Fig. 18.

3. *Working capacity per acre or per acre foot might have a considerable influence on the cost of storage rights.*

4. *Gathering and treating systems include gas conditioning equipment, metering and regulating facilities, pipelines and fittings, traps, emulsion-breaking apparatus, and liquid storage tanks.* They may be simple or complex depending on contaminants in gas, number of wells and distance between wells.



Unit annual cost of high pressure holder station gross withdrawal.

5. *Wells used for underground storage injection and withdrawal are known to vary in depth from about 1500 to 8000 ft.* Each additional foot of depth adds about $13.00 to the cost of a well.

6. *Deliverabilities of individual wells could vary from about 5 to 75 MMcf per day.* Obviously lower deliverabilities will increase capital requirements.

As pointed out above, underground storage reservoirs are used for seasonal, week-day, week-end and hourly load equation. These various functions are illustrated in Fig. 19, 20 and 21.

The capital requirements of underground storage were related to gross withdrawal capacity and deliverability. And the data are shown in Fig. 22, 23, 24 and 25.

Annual costs were similarly treated and the results are shown in Fig. 26, 27, 28 and 29.

Specific operating conditions for the development of a hypothetical underground storage reservoir are detailed in Table 8.

Acknowledgment

This article developed from a paper presented at the 1957 AGA Chemical Engineering, and Manufactured Gas Production Conference, Bal Harbour, Florida.

TABLE 8. Specified Operating Conditions for the Development of a Hypothetical Underground Storage Reservoir.

Line	12 Months Ended October 31	Column A 1956	B 1957	C 1958	D 1959	E 1960	F Each Subsequent Year
1.	Top pressures (psig)	2,000	2,000	2,000	2,000	2,000	2,000
2.	Base pressure (psig)	1,000	1,000	1,000	1,000	1,000	1,000
3.	Acres (Storage Rights)	225	225	225	225	225	225
4.	Native gas (MMcf)	2,591	2,591	2,591	2,591	2,591	2,591
5.	Additional cushion gas (MMcf)	2,591	2,591	2,591	2,591	2,591	2,591
6.	Working volume (Mcf)	12,955,000	12,955,000	12,955,000	12,955,000	12,955,000	12,955,000
7.	Number of wells required to meet maximum delivery	3	11	19	25	36	43
8.	Total gas withdrawn (Mcf per year)	2,591,000	5,182,000	7,773,000	10,364,000	12,955,000	12,955,000
9.	Withdrawal from field (days per year)	59	59	59	59	60	59
10.	Rate of production (average Mcfd)	44,000	88,000	132,000	176,000	220,000	220,000
11.	Rate of maximum delivery (Mcfd)	54,900	196,700	329,000	451,900	653,200	777,400
12.	Total gas injected (Mcf per year)	5,182,000	7,773,000	10,364,000	12,955,000	12,955,000	12,955,000
13.	Injection into field (days per year)	261	261	261	261	261	261
14.	Horsepower installed	3,762	5,640	6,840	6,840	6,840	6,840
15.	Field inoperative (days per year)	45	45	45	45	45	45

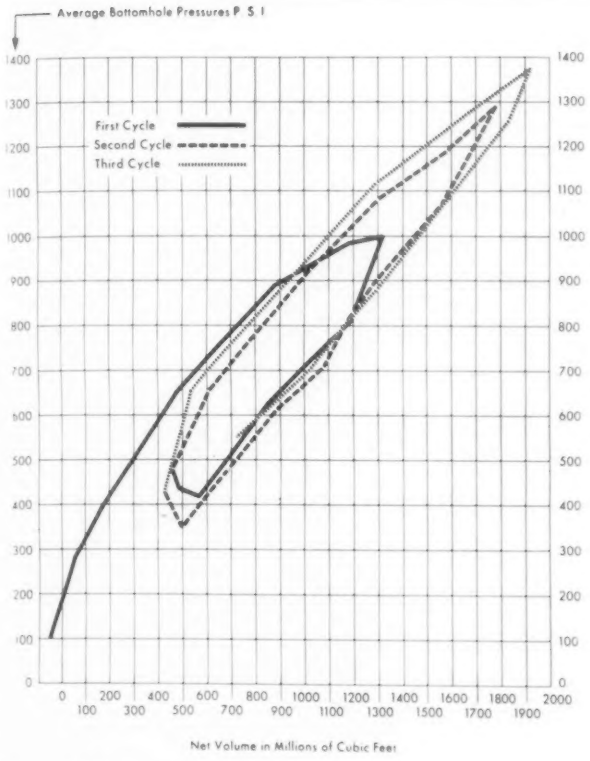


FIG. 18. Volume pressure relationship.

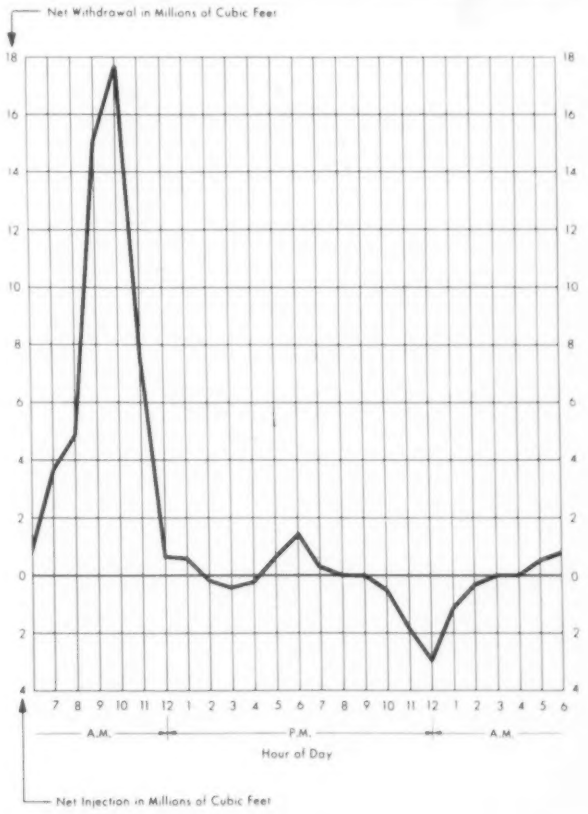


FIG. 19. Hourly load equation of underground storage typical winter day.

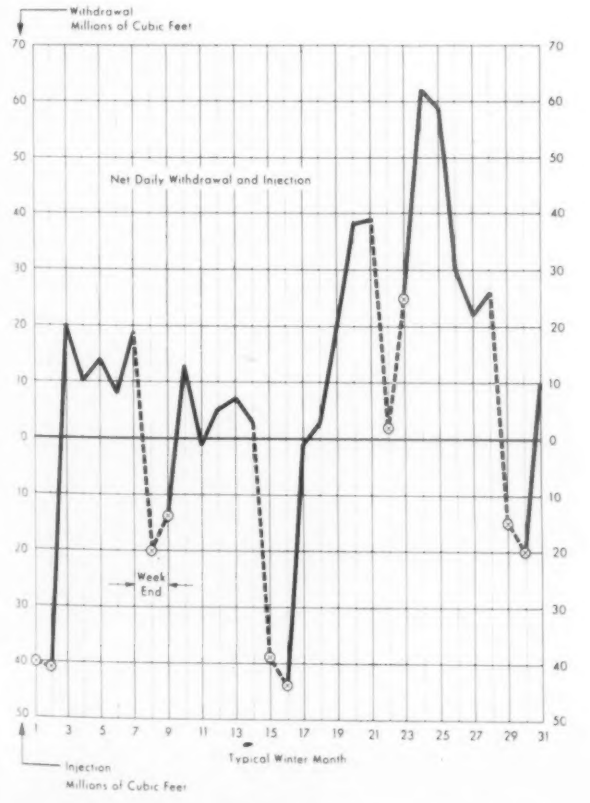


FIG. 20. Underground storage weekday—weekend load equation.

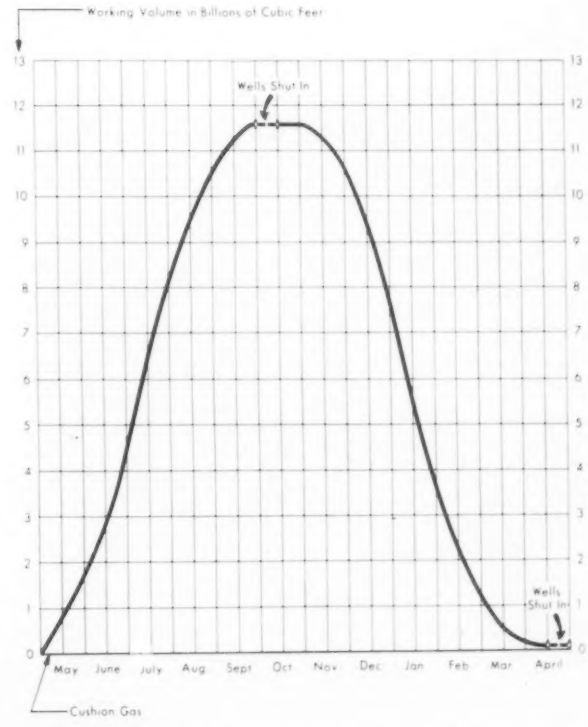


FIG. 21. Seasonal function of an underground storage project.

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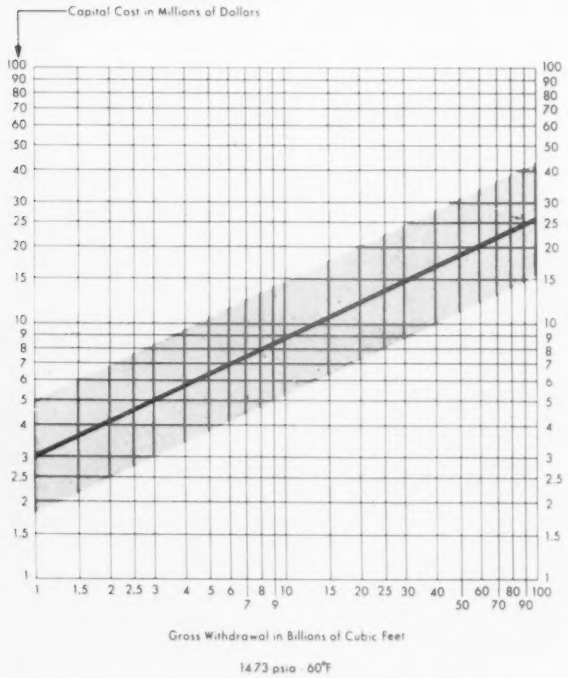

FIG. 22. Capital cost of underground storage gross withdrawal capacity.

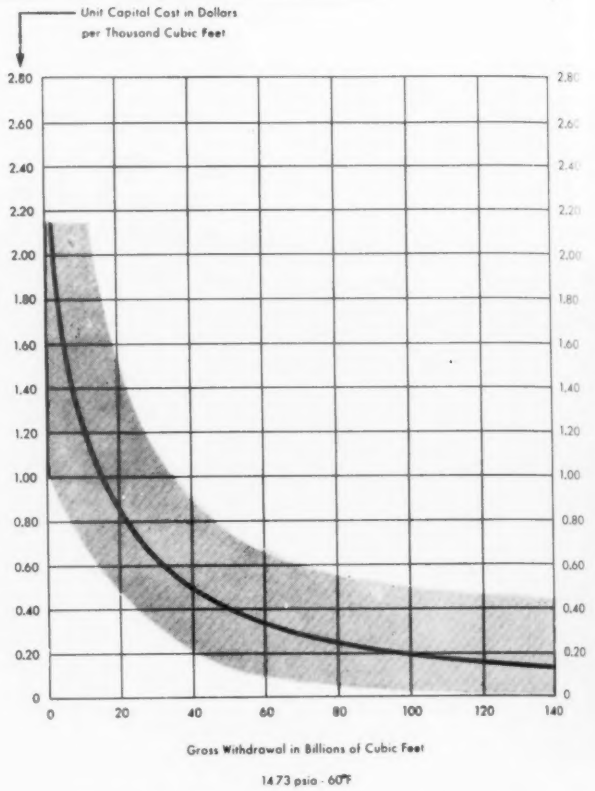

FIG. 23. Unit capital cost of underground storage gross withdrawal capacity.

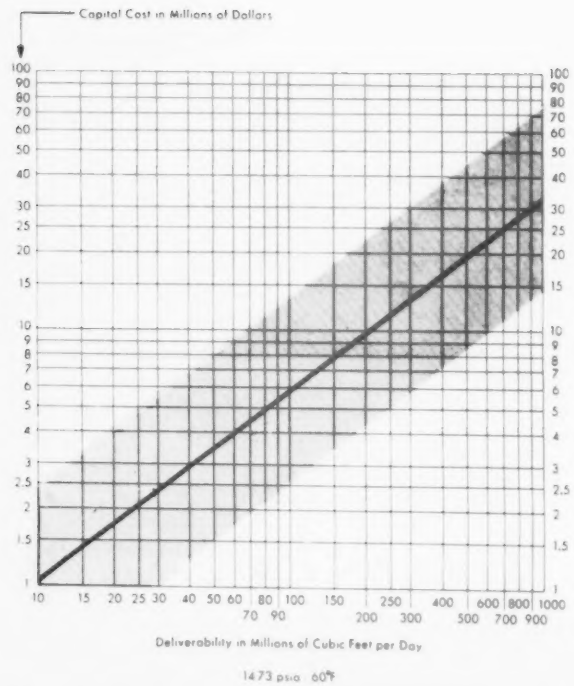

FIG. 24. Capital cost of underground storage deliverability.

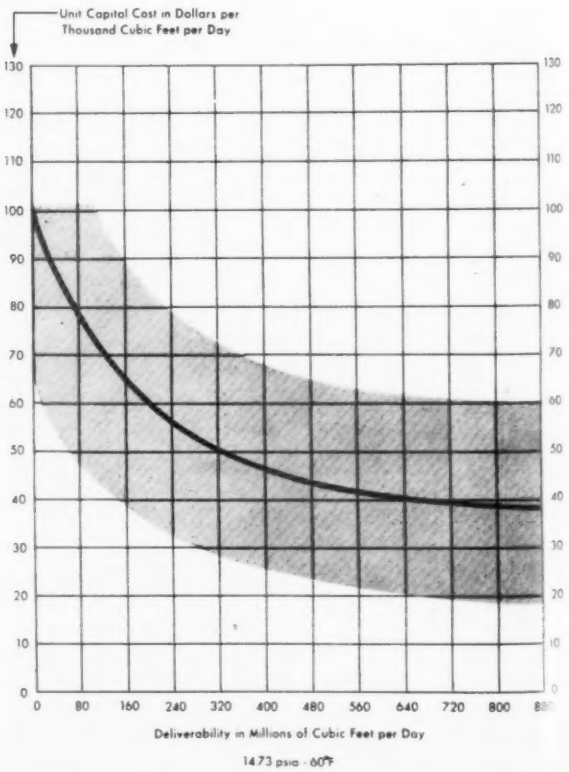
Unit Capital Cost in Dollars per Thousand Cubic Feet per Day
Deliverability in Millions of Cubic Feet per Day
14.73 psia - 60°F

FIG. 25. Unit capital cost of underground storage deliverability.

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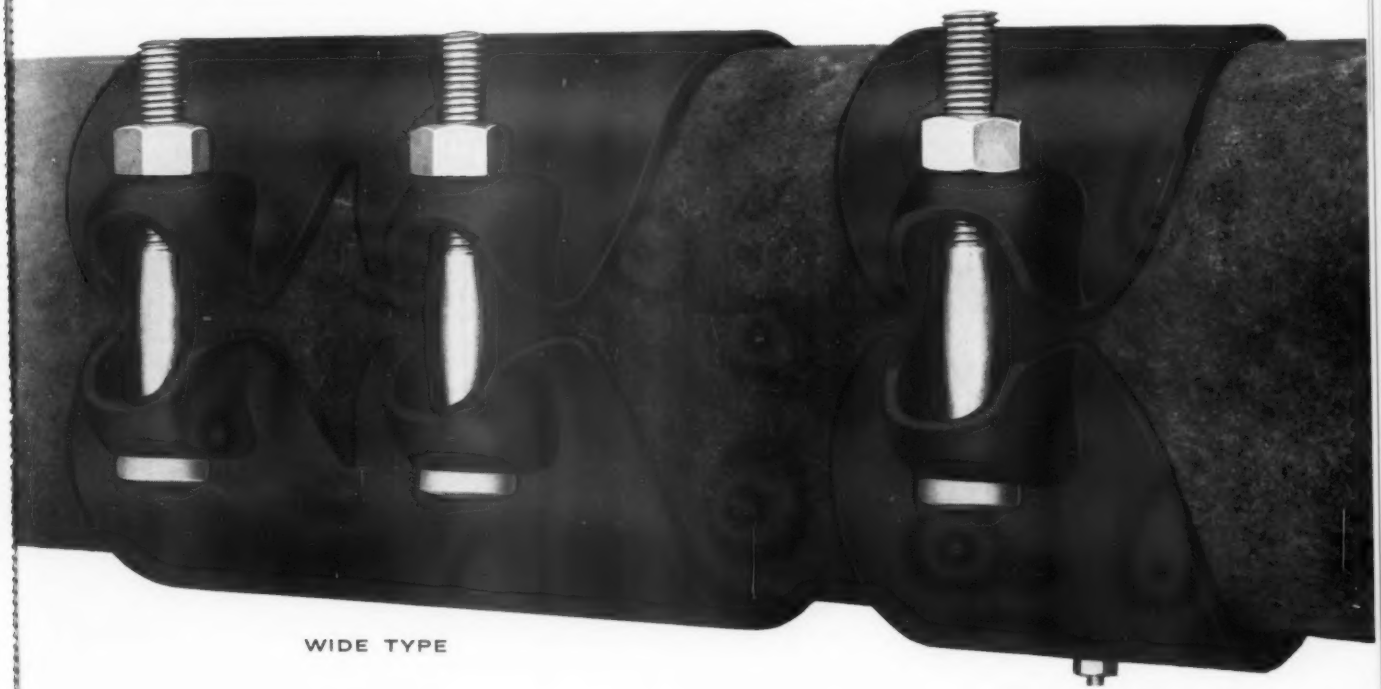

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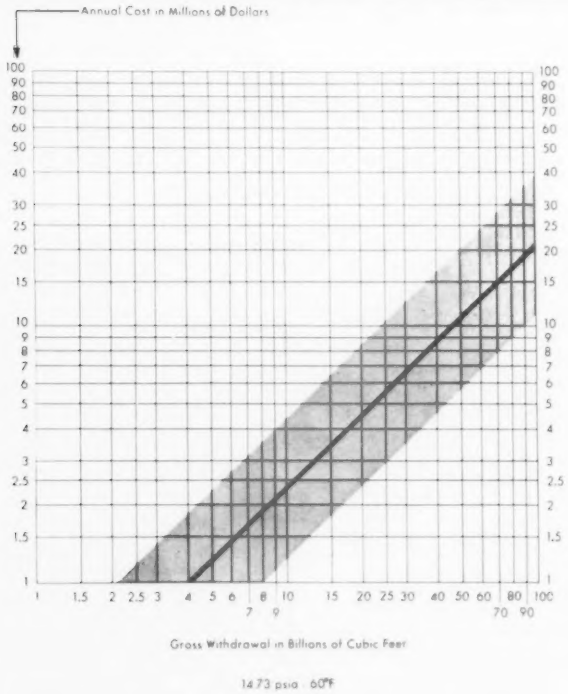

FIG. 26. Annual cost of underground storage gross withdrawal.

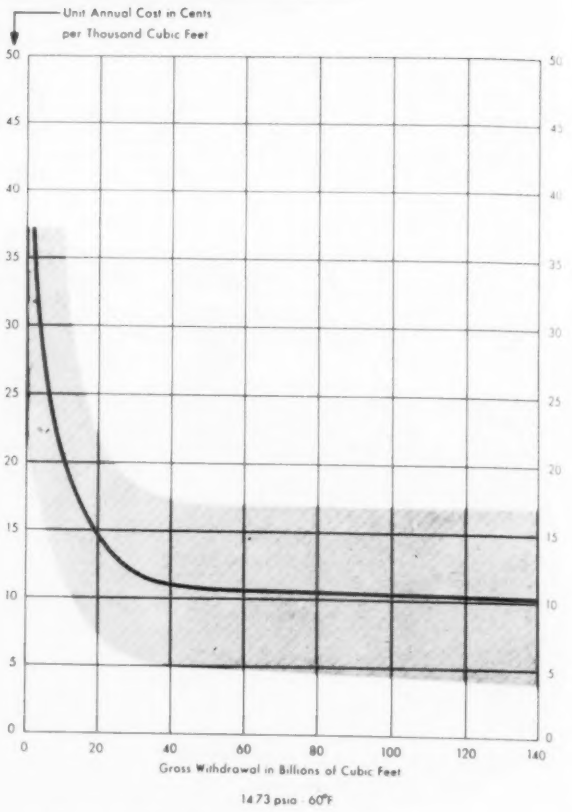

FIG. 27. Unit annual cost of underground storage gross withdrawal capacity.

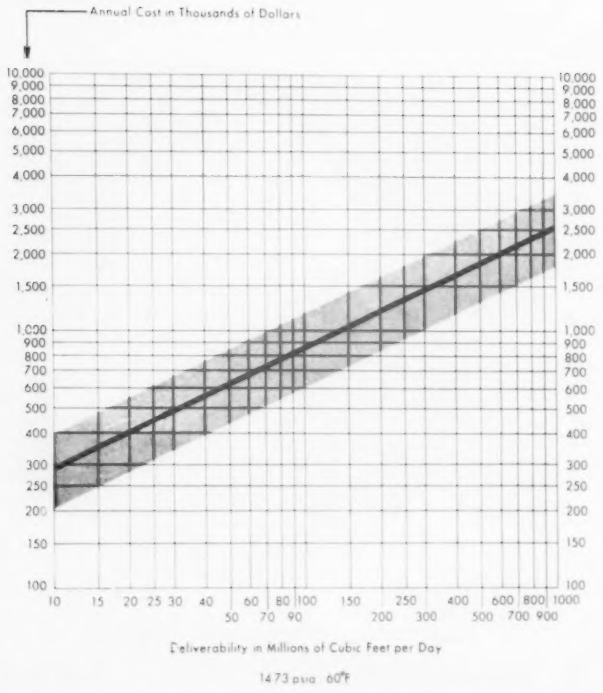

FIG. 28. Annual cost of underground storage deliverability.

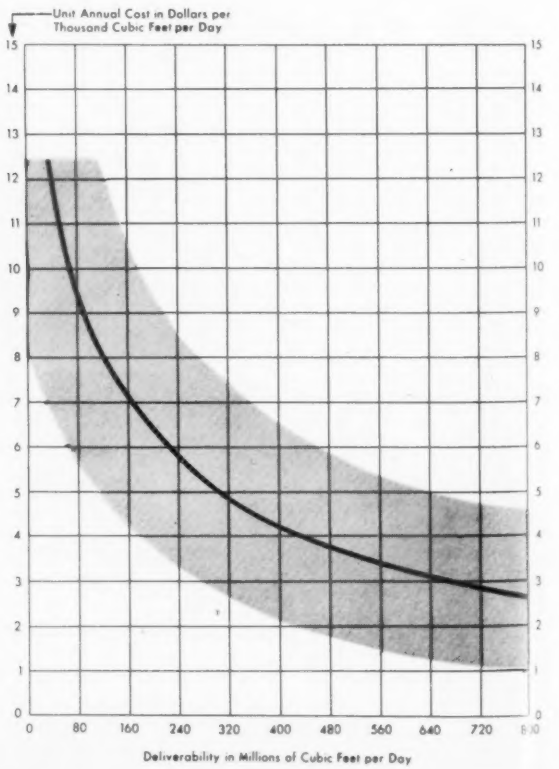

FIG. 29. Unit annual cost of underground storage deliverability.

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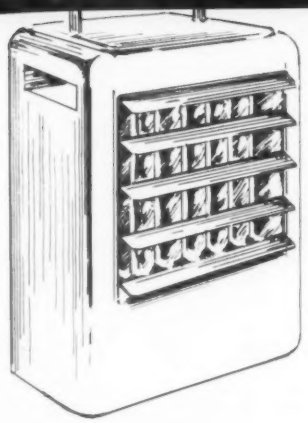

What You Should Know About

Gas-Fired

Unit Heater Applications

Myron W. Ryder
Supervisor of Utilization
Cambridge Gas Company
Cambridge, Massachusetts

THERE are many and varied uses for a unit heater — the workhorse of commercial and industrial heating. Basically, unit heaters are comprised of a gas burner, a heat exchanger, fan, and set of controls, all encompassed in an outer casing. They use two types of fans, namely a propeller fan which operates against practically no static pressure and the blower fan, which operates against static pressure.

Theoretically, the unit heater with the propeller fan should not operate against any static pressure but should have full opening of the unit heater face. Generally, duct work should not be taken off the full face of the unit heater equipped with a propeller type fan. There are conditions, however, where one quarter of the face of the unit heater may be used for a small duct not exceeding 8 to 10 ft in length for spot heating. When it becomes necessary to use duct work with a unit heater to direct heat at a desired spot location, it is mandatory that the unit heater be equipped with a blower type fan.

There is also a unit heater rated as the *heavy duty heater,* which has capacity in the millions of Btu. This type of unit heater generally rests on the floor. A blast of hot air is circulated as required to heat factories, warehouses, and steel fabrication buildings, where uniformity of heating is not critical but the working space must be maintained above a given temperature.

A unit heater that must be suspended at a height greater than 12 ft above the floor must have a high velocity nozzle in order to get the desired heat to the working area as well as to keep the hot air from rising to the roof level.

Air Flow

Louvers are supplied with unit heaters in order to direct the flow of air and they can be mounted in a horizontal position, vertical position, or combination of both. An installation in a supermarket, grocery store, or similar business establishment must have louvers so arranged that warm air is not directed at a fruit counter, vegetable counter, or a deep freeze unit. It can be readily imagined what would happen if the heated air were directed at these items.

If it is necessary to have spot heating in two locations, a splitter nozzle can be attached to the face of the unit heater which will give a 50-50 throw or 70-30 throw as required.

There are instances that require the unit heater to be hung behind a partition and this type of installation has certain limitations. The unit heater must be mounted at least 12 in. behind the partition. The cross sectional area of the duct from the face of the unit heater to the partition opening must be the same size as the face area of the unit heater. A return grille must be installed in the base of the partition and have an area 10 percent greater than the discharge grille together with a return duct to the unit heater of full cross sectional area.

Venting

Venting is an important part of the installation. It should be remembered that a draft hood is built into the unit heater. The vent from the top of the unit heater through a side wall of a building to an outside tee, and then vertically to the proper height above the building will require proper drainage of the condensate.

The bottom of the tee must not be left open for draining the condensate. Such an installation would give the effect of two draft hoods and proper draft would not result. The bottom of the tee outside of the building should be capped and a very small hole left in the cap for condensate drainage. A nipple and a gas cock should be attached to the bottom of the cap in order that periodic drainage may be secured. It is self-evident that a proper type of cap should be installed on the top of the vent.

There are instances where a vent will not function because the building has negative pressure, causing the normal draft to reverse itself. An exhaust fan must be used. In such cases the use of a reverse acting vaporstat mounted on the manifold of the burner, to control the operation of the exhaust fan, has been successful. This type of control will cause the exhaust fan to operate at the same time the burner comes on and will stop the fan when the burner shuts off.

Returns

Returns may be used with unit heaters provided they are installed properly. More uniform heating can be secured if the heated air is blown into the room at the unit heater level and a return duct from the back of the unit heater is carried down to within a few inches of the floor. Basically, this will cause the cooler air on the floor to be taken into the heater for reheating and at the same time have the tendency to pull the warm air closer to the area requiring the heat.

If it becomes necessary to use air ducts with propeller type fan unit heaters, it is absolutely necessary for the cross sectional area of the duct to be the same as the full face opening of the unit heater. The duct must not be over 10 ft in length including any bends. If it is necessary to have a bend in the duct, the bend must be at least 12-in. from the face of the unit heater and must be vaned to provide a streamline flow for keeping the static pressure at a minimum.

It is common practice when installing unit heaters to "sweep" the perimeter of the space being heated. I would like to caution against trying to get the maximum throw from each in-

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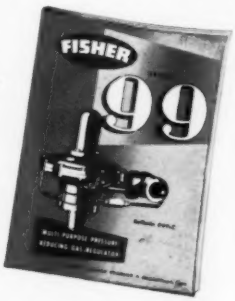

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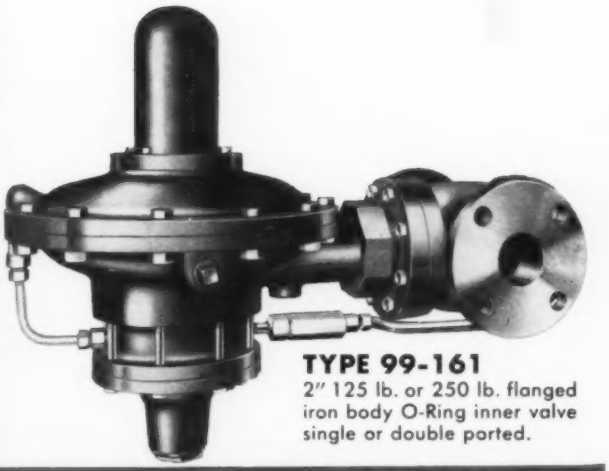

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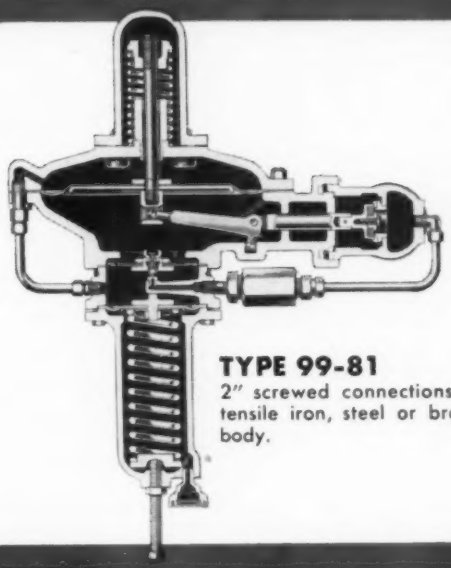

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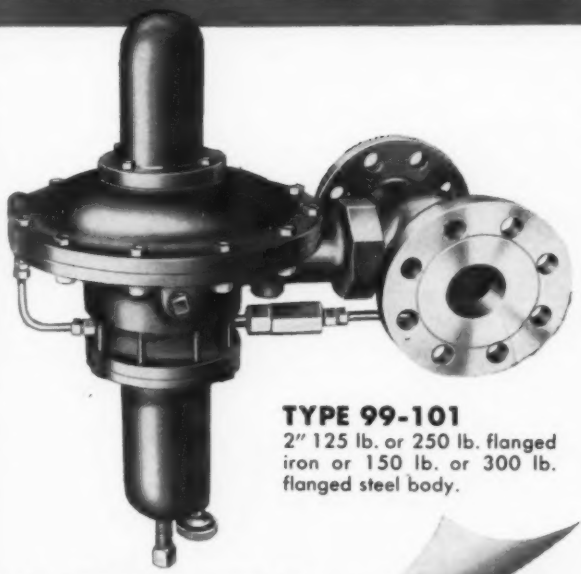

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dividual unit heater. If this is attempted, considerable variation in space heating will result. It is preferrable to install two heaters and secure more uniform heating. A similar situation — such as air noises and drafts — results when large size unit heaters are used. It is far better to use two small unit heaters than one large one in those cases where draft and air noises would be objectionable.

Comfort

The degree of comfort must be considered when installing unit heaters. Comfort is a very relative term. Comfort in a supermarket is entirely different from that in a beauty shop, ladies dress shops, factory lunchrooms or tea rooms. In most supermarkets, individuals are entering from the cold outside air, have on heavy clothing and are walking around the market. As long as the market is relatively comfortable, little or no complaints will ensue. However, those establishments where ladies gather for tea or conversation, comfort must be of a higher degree and the noise must be of a low level. These factors and similar ones must be considered prior to recommending equipment for installation of unit heaters so that complaints may be minimized.

Four unit heaters may be put in the center of the area to be heated which will result in one common flue. It must be remembered that the spacing of the four unit heaters is critical for if they are too close in grouping, one unit heater may tend to draw from the other, causing erratic operation.

It is also advantageous in many ways to use two unit heaters rather than one to accomplish a given result for they will produce a maximum of comfort heating, least noise, and adequate air distribution.

Cleaning

It seems hardly necessary to mention the fact that unit heaters must be installed so that they can be properly cleaned. In one instance an outside contractor sat the unit heaters on an "I" beam and firmly fixed them in position — which meant they could not be cleaned. It is hard to realize that such a condition could exist. During installation, close supervision should be maintained.

Space-Saving

One of the main attributes of a unit heater is the fact that it can save space. In the initial heating layout of a newly constructed industrial or commercial building, it is cheaper to install unit heaters to furnish the heating requirements. Originally, in the blueprints of a new building, there will be a room indicated as the heater room and probably one indicated as the fuel storage space. The use of unit heaters eliminates the original purpose of both areas and make this space available for other use.

Noise

It is important that noise be considered. Like comfort, noise is a relative term. What is noise to one person is not so to another. Conditions vary the intensity of noise. For example, concrete floors and concrete walls amplify the noise, while a carpeted room with drapes has a tendency to absorb noise. When an individual customer indicates that he wants quiet operation, one must determine what is **quiet.** Quiet in a busy store or a printing shop is entirely different than quiet in a reading room. Quiet in a funeral home is **silence.**

Summer Switches

It is good practice, when installing unit heaters, to include a summer switch. This lets the customer have air circulation during the summer months, that will create a more comfortable environment.

Codes

It is well to take into consideration the stipulations of the local codes whether they be state, municipal, or those promulgated by the gas company. In such codes you find reference to explosion-proof motors for use in buildings that have explosive atmospheres. It will often be found that unit heaters must be of a certain height above garage floors. Be sure that any installation does not conflict with local codes.

Case Histories

Some of the unusual heating problems or requirements are rather interesting.

The Navy Pier in Chicago is an outstanding example of what can be done with unit heaters. This building is some 2300 ft long by 70 ft wide, and constructed of concrete and glass. It juts out into Lake Michigan and has three sides and a roof exposed. It was quite a problem to determine how to heat this building in order that it might be used during the winter months for conventions or other public gatherings. The problem was accepted by one large manufacturer of unit heaters and an excellent job of heating was done.

Greenhouses and florists shops have been heating very successfully with unit heaters. One greenhouse used unit heaters to force their plants for Easter with remarkable results. Florist shops have had no adverse effect on the flowers provided the heated air was properly directed with louvers.

Another successful application is the **drying of statues.** The customer designed a room approximately 10 ft by 10 ft by 10 ft, mounted a unit heater outside of the room directing the heated air by a properly sized duct into this room and had a return duct to the unit heater. After his statues were made and/or painted, they were put in this room and very successfully dried without any spalling or cracking.

Many times unit heaters are used as an **air barrier or baffle.** Large buildings that have a vestibule entrance may have a unit heater between the two entry doors so that when the outer doors are opened, a blast of hot air seals the doorway and prevents any cold air entering. This principle has been used successfully in large garages, steel warehouses, and similar large buildings.

Heat gains from the heat generating equipment often enter into the sizing of a uint heater. In a foundry, in a forging shop, in a plating shop, one can readily see that there is heat available that tends to heat the area. Therefore, the unit heater does not have to do all the heating. Similarly, there is the condition where we have a crowd of people such as a gathering in a hall wherein bodily heat is present and will have an effect on the sizing of the heater.

Garages create a peculiar condition in that the heater may of necessity be larger than that required to furnish the building heating requirements. During the winter months, buses or trailer trucks will enter the garage and, being very cold, will add an additional heating load that demands adequate capacity in the unit heater to offset this cooling effect.

Intermittent heating also may require oversized unit heaters where a fast pick-up is required, as in buildings such as halls or churches that are used periodically.

In some installations, corrosive atmospheres may be present. In those processes where cutting oil and/or carbon tetrachloride are present, products of combustion will be of a corrosive nature and may have an adverse effect on equipment.

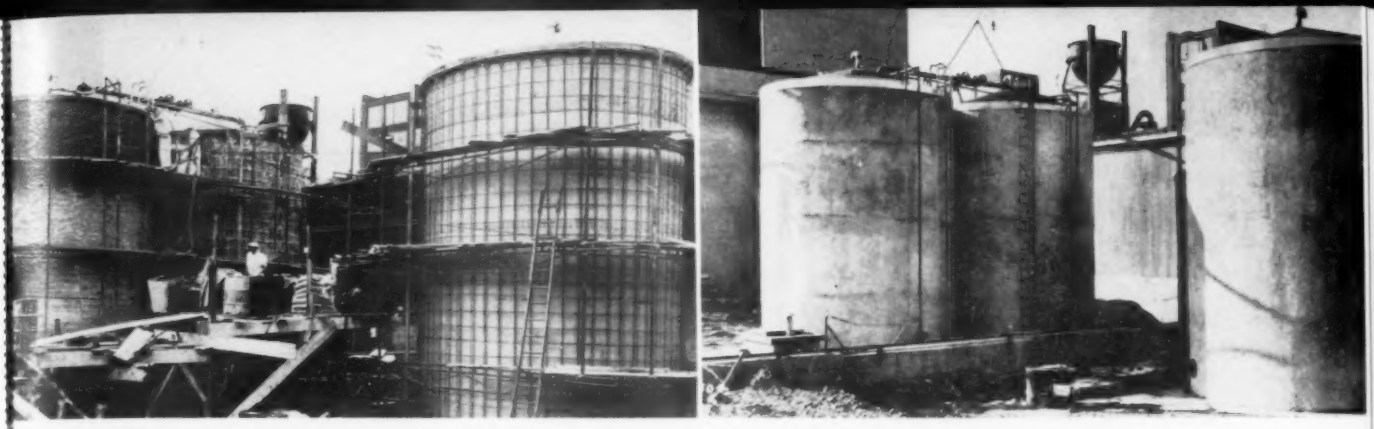
In summation, it should be pointed out that the gas company is called in as the expert. Do not be afraid to accept the job, for it is a preliminary study that the customer has asked you to give him with your recommendations. You may accept the job or you may wish to turn it down. At least you have given the customer courteous consideration.

One further suggestion — always be sure you have sufficient heat. If you do, you can always reduce it. If you do not have sufficient heat, there is little or nothing that can be done other than having a very irate customer!

Acknowledgment

This article developed from a talk presented at the 1957 New England Gas Association Commercial-Heating-Industrial Conference, Providence, Rhode Island.

* * *



Three different construction stages in the fireproofing and insulating of tanks. In initial step, tank at right is surrounded with a paper-backed wire lath attached to a steel stud framework. Next step (center tank) is the spray-gun application of the first coats of perlite concrete. Reinforcing mesh is still visible. Final coats of perlite concrete are being applied to the tank at left. When completed, the concrete barrier measured six inches deep. **Completely fireproofed** (photo at right) tanks meet fire regulations.

Ideas at Work

Fireproofing, Insulating Storage Tanks

Are storage tanks at your gas plant a problem? Here's a new method for securing safe storage, eliminating losses through evaporation, and minimizing maintenance costs in one operation.

STORAGE tanks of all sizes can be protected from the dangers of fire and evaporation loss with a new technique employing a perlite insulating concrete. The new technique is particularly adaptable in those gas utility plants where oil is stored for use in gas manufacture. It can also be adapted for use in protecting LPG storage tanks.

Typical application of the new methods is illustrated in its use on three tanks at a Philadelphia plant. In this case, the firm involved wanted to enlarge a building that was very close to the 50,000-gal tanks, but was unable to do so because of local fire regulations. Approval was granted, however, after the tanks were fireproofed with concrete made of perlite. Perlite is an expanded volcanic mineral used in place of much heavier sand in insulating concrete.

In addition to improving fireproof qualities of a concrete, it serves as an effective insulator to minimize evaporation loss, protects metal tanks from corrosion, and helps cut tank maintenance costs. The white perlite concrete also creates a pleasing, textured, monolithic surface that is easy to keep up.

Application Is Simple

Application of a 6-in. thickness of perlite concrete around the tanks (18 ft diameter by 27-ft height) was simple, efficient, and economical. It was machine-sprayed onto a paper-backed wire lath which had been attached to a steel stud framework erected around the tanks.

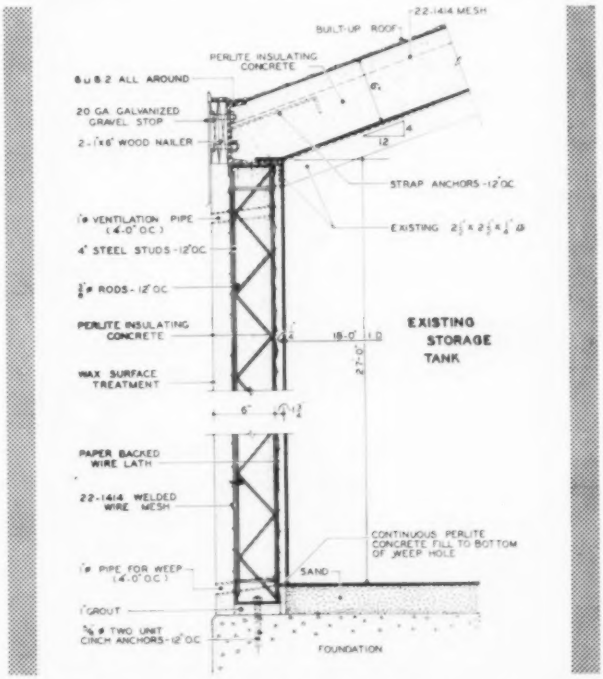
This framework was connected only at the top of each tank and to runners circling the base. Thus the concrete protection was built structurally independent from the metal tank exterior so as to provide a 1¾-in. dead air space. The insulating property of the perlite concrete barrier together with the dead air space is calculated as having a U value of .16. (U equals the heat transmission in Btu per hours, per square foot, per degree F of temperature difference from air to air of a given building section.) This insulation value is equivalent to that provided by more than three feet of structural concrete.

When completed, the concrete was waterproofed. Tank tops were also protected with perlite concrete and then covered with four-ply membrane gravel roofs.

Composition of the concrete mix was as follows: 4 cu ft of perlite to 1 bag of portland cement, 5 lb Lumnite cement, 3 oz of NVX air entraining agent (vinsol resin solution) and 62 to 64 lb of water. Perlite concrete sprayed walls of this construction are approved for 4-hour retardant ratings. They may be applied with spraying equipment.

Fire-retardant quality of perlite concrete is due, in part, to the fact that perlite concrete when exposed to fire releases chemically-combined water in the form of vapor. This action limits the temperature to 212 F until all the water has been driven off. Additionally, concrete made with perlite instead of heavy aggregate has limited expansion at high temperatures. Consequently, there is a minimum of cracking upon exposure to flames preventing fire from penetrating the concrete barrier.

* * *



Cross section of fireproofed tank protected from fire hazard and evaporation loss by a 6-in. barrier of perlite insulating concrete. Concrete is sprayed onto a paper-backed wire lath attached to steel stud framework erected around the tanks. Framework was connected only at tank top and to runners circling the base. When completed, concrete surface is waterproofed with a special wax preparation.

Completing the Gas/Oil Well

AFTER a well has been drilled to the desired depth, casing must be set to provide a permanent hole for the production of gas and oil at the surface for use or sale. The techniques involved are referred to in the oil field as **completion operation.** The importance of this phase of activity in securing production is reflected in the relationship of its cost to that of drilling the well. The materials and services used in completing and equipping the well amount to roughly *twice* the cost of drilling the hole. In addition, great skill, training, and experience are mandatory of the personnel responsible for completion work to insure maximum economic benefits.

Setting Casing

Various factors influence the amount and size of casing that may be used in a well. In the previous chapters on *Methods of Drilling* it was pointed out that an *initial or surface string* of casing is necessary to provide an anchor for the blow-out preventers. The surface string is also needed to shut off the entry of water into the hole from surface sands and to prevent contamination of those same sands with mud, salt water, gas or oil from the drilling well. The length of this pipe in the hole may vary from 50 to 1500 ft.

Between the base of the surface casing and the total projected depth of the well, other conditions may be encountered that will require casing to protect the hole and permit continued drilling with safety. Pipe, used in this manner, is referred to as *intermediate casing.* It may be used to seal off strong water flows or to bolster weak hole walls. Sometimes soluble materials, such as salt, are encountered that will endanger continued drilling unless they are isolated with casing.

Finally, the pay section is reached and all points between it and the surface must be excluded to permit effective production. This is called the *production string.* Different considerations dictate the base point for setting of *landing* this casing.

When the production string of casing is run, the operator has the choice of setting casing through the pay or on top of the pay zone. If the casing is cemented at the top of the productive horizon, in what is known as *open hole completion,* this may be accomplished with special cementing tools after drilling through the zone. Or, the hole may be drilled to the top of the pay, casing run, and the productive section drilled out below the pipe after the cement has set.

The advantages of setting casing through the pay zone are that the operator has more control over the entry of gas, oil, and water into the well and the ability to be more selective as to the portions of the rock to be tapped for production.

After the cement has hardened around the casing, the oil or gas from desired portions of the strata is conducted into the casing by holes made through the casing and cement.

These *perforations* are created by shooting bullets from specially designed guns through the steel casing wall and cement jacket into the surrounding stratum. There are many designs and sizes of perforating guns but all are lowered into the hole with cables running over carefully calibrated reels that compute the position of the gun in the hole. In this manner, the gun is stationed precisely for firing.

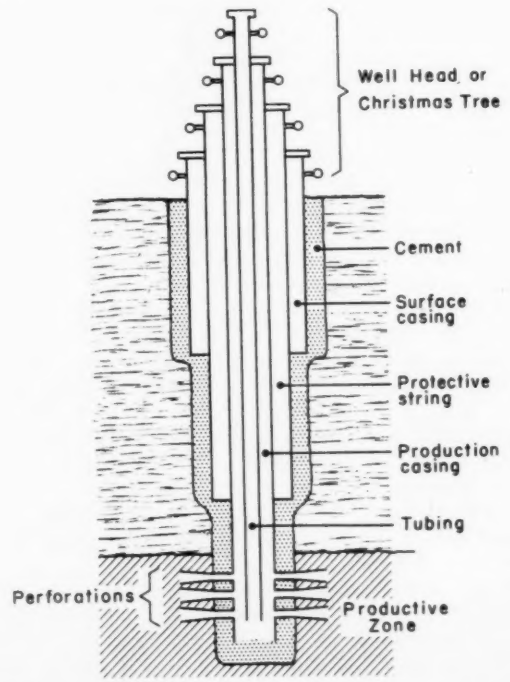
The number of shots expended may vary from one, or very few, to several hundred, depending on the nature of the formation and its contents. Practically all modern gas wells are completed by setting pipe through the pay section and perforating selectively to conduct the gas into the well.

Open-hole completions are advantageous when oil is contained in the rock under low pressures. In such cases, it is desirable for the oil to have as free access into the hole as possible.

The method of running and cementing casing is the same with all strings. As described in the chapters on *Methods of Drilling,* the casing is put into the hole in a manner similar to the handling of drill pipe. Cementing is done by forcing cement slurry down through the pipe and up and around the outside to fill the annular space. The cement is pushed down by a column of water or mud, sometimes with the aid of a plug, and held in place until it hardens.

Well Heads

On the surface, each string of casing is surmounted by a *bradenhead,* which is a device to permit control of the contents of the pipe. These heads are doughnut shaped and



Schematic shows arrangement of multiple casing settings and bradenheads

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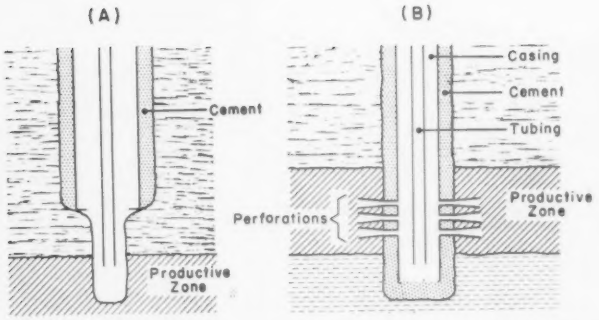


Open hole completion — Casing set thru productive formation

sized to fit both the casing to which they are attached and to close against the next pipe to be run. In this manner the space between nested casing is sealed and access established at the wellhead by valves.

The final head, usually called the *casing head*, is screwed or welded to the oil string and is capable of receiving the tubing. Valves and gages maintain control of, and access to, the annular space between the casing and the tubing as with the casing to casing contact.

The tubing is, likewise, topped by a *tubing head*. If the well flows, the top is blanked off and the flow directed through appropriate valves. In the case of a pumping well, a hole in the top is provided for the insertion of sucker rods and a stuffing box, for sealing, is added to close around the polish rod that is precision ground to reduce wear on the flexible sealing rubber as the rod moves up and down in the pumping cycle.

Upon completion, all of the heads are bolted together and, with their array of valves and gages, become a unit known as the *Christmas tree*. Reference to the accompanying illustration will supplement the explanation of the structure of this piece of equipment.

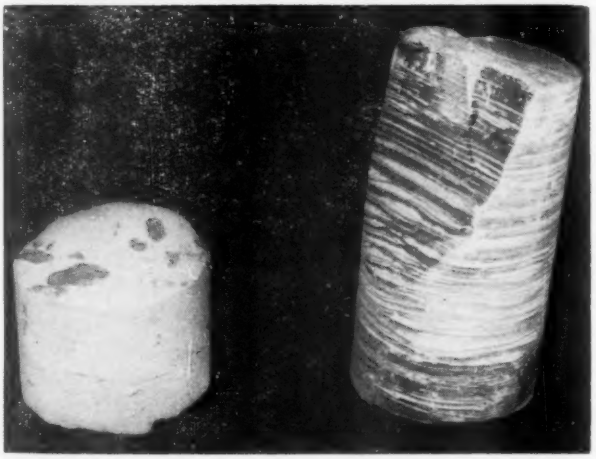
Determining Whether to Set Pipe

Obviously, all of the expenditure of setting casing will not be made unless there are sufficient indications that a commercial well can be made. The decision to complete a well is generally based on a careful study of data obtained from several sources.

Cuttings and Cores

One of the primary sources of information on the progress of the well and its potentialities come from the samples of cuttings. As the rock is chipped away by the bit, the particles are carried by the mud stream to the surface where they are separated from the mud. At intervals, samples of these cuttings are taken for examination. The geologist is able to determine, by analysis, both the formation being drilled and, to some extent, the gas, oil or water content.

If the samples are not conclusive, but indicate possibilities, the rock may be *cored*. A special bit is used to leave a section of the rock standing in its hollow center (much like a biscuit cutter) as it drills ahead. This *standing core* is entrapped in a core barrel above the core bit and brought to the surface for analysis.



Cores. At left is sandstone, at right is shale. Both were taken from a Wilcox formation between 900 and 10,000 ft.

Often, the core is sealed in a special container and rushed to the laboratory immediately after being withdrawn from the core barrel. Trained scientists there subject the core to a number of tests to determine the relative gas/oil/water content, the porosity, and the permeability. The information, thus obtained, becomes the basis for estimates of the value of the minerals in place.

If drilling has progressed through a formation before it is decided that a core is needed, the sample may be taken by *side wall coring*. This is accomplished by lowering a cutting barrell into the bore hole on a wire line. Electrically detonated charges drive small cutting heads into the formation at desired points. Multiple cores may be secured this way. They are retrieved by raising the barrel, with its captive pendulant core catchers, to the surface.

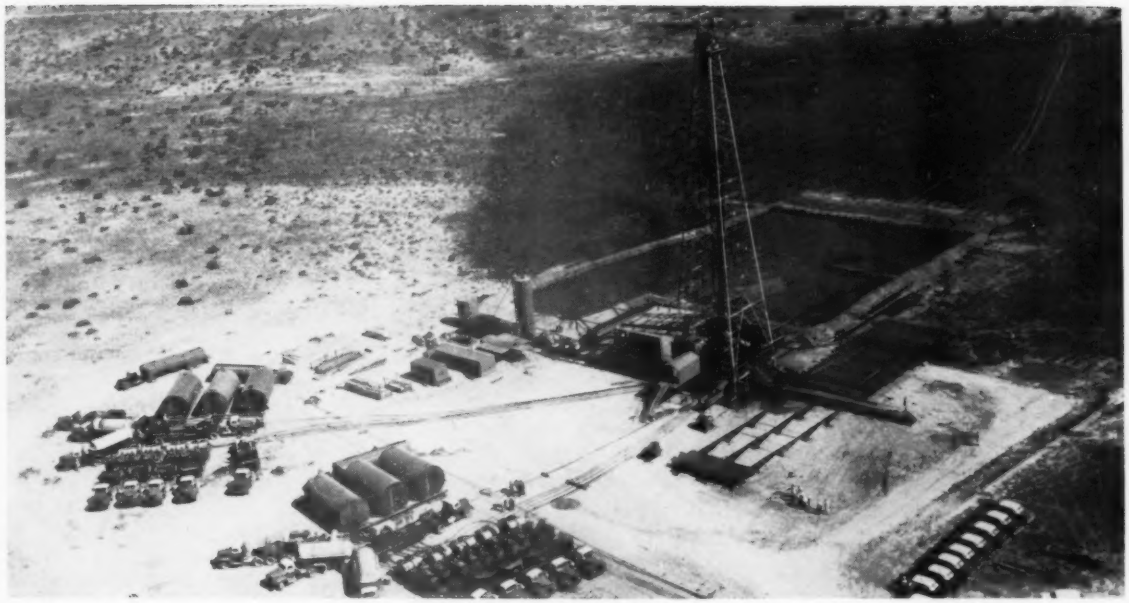
Electrical Logging

In addition to tabulating the characteristics of the well bore from the cuttings, the well may be *logged* with electrical devices. For this purpose, electrodes are lowered into the hole and slowly withdrawn. A continuous recording device measures the relative resistivity of the formations to the flow of electrical energy flowing in a circuit around the electrodes. Measurement is also made of the "self-potential" or the ability of the formations to generate minute quantities of electricity.

Comparative experience with the results of such logs from hundreds of wells enables the geologist to interpret the results in terms of oil and water; shale, lime and sand. To date, no definite interpretation for the presence of gas is possible from the usual electrical log.

Resistivity and induction logging, just referred to, is done in the open hole. After pipe has been set, it is ineffective. But, the well can be logged electrically, through the casing, by measuring *radioactivity* to obtain similar results. The relative strength of gamma ray penetration is charted continuously as the sensitive electrode is slowly withdrawn from the hole. The resulting log is analyzed in much the same fashion as the more conventional log.

Christmas tree — consisting of high pressure flanges and valves to control flow of gas and oil from underground reservoir to surface.



King-size fracturing job in process on potential gas and oil well. Note large amount of equipment required.

Gas Detection by Mud Analysis

The most successful method, at present, for detecting gas in the hole is the *gas "snifter" device*. Portable laboratories are set up on well sites and drilling mud is continuously examined as it returns from the bore hole. All of the mud characteristics are noted and any addition to the mud stream from the formation is detected. Very delicate instruments are capable of discovering the most minute quantities of gas. The depth of such gas is recorded, and careful comparison with other logs is made later.

Drillstem Testing

If a possible productive zone is encountered that is unevaluated, the operator may want additional evidence of the amount of gas or oil to be expected from the saturated formation. In such a case, a *drillstem test* may be taken. The bit is withdrawn and a special tool is run back into the hole on the drillstem just above the formation to be tested. This device has a section capable of expansion in such a manner as to seal or pack off all of the open hole above it from that portion directly below that is to be tested.

After the packer is set, the lower end of the testing tool may be opened to allow the entrance of gas or oil that may be coming from the formation. In some cases, the pressure is great enough to allow the gas, oil, or water to flow through the drillstem to the surface. If not, the amount can be calculated by closing the tool, to retain whatever it has entered; and, thereafter, withdrawing the pipe.

Counting the number of joints or "stands" of pipe that contain fluid and noting the characteristics of the contents gives an indication of the kind of well which may be expected. For comparative purposes, the amount of time the tool is allowed to remain open is recorded. This type of test is always run in the open hole.

Bringing in the Well

Having ascertained that there is a good chance of making a well, the casing is run and cemented. When the cement has set the well is ready for the final steps in completion. If the casing has been set on top of the pay, for open hole completion, it is now *drilled in* by drilling out the cement plug and penetrating the producing formation for the desired number of feet. If casing has been set through the pay zone, a perforating gun is run and holes made, as previously described, through the casing and cement and into the rock.

After contact has been established with the reservoir of gas or oil, either by open hole or through perforations, *tubing* is run into the well. Efforts are then made to start the well to flowing. Sometimes the well has sufficient pressure to bring the gas and oil to the surface as soon as it is opened up. If flow is established, the well may be tested by flowing at varying rates, through different sizes of orifice valve openings, to determine the most efficient volume of production with the minimum pressure drop. The amounts of pressure on both the tubing and casing are closely watched because of their importance in relation to the production of gas and oil.

Swabbing

If the well fails to flow, artificial means of stimulation may be required. The most common means of starting the well is by *swabbing*. A close fitting cylinder, resembling the traveling barrel of a pump, is lowered into the tubing by a wire line until it has fallen far enough into the fluid of the tubing to pick up an adequate load. Thereafter, it is rapidly withdrawn to carry above it an amount of fluid to the surface. A simple ball and seal valve retains the load of liquid above the swab on the outward trip but permits the tool to drop easily through the fluid.

The swabbing process reduces the height of the column of fluid and thus reduces the pressure exerted by the column on the formation at the bottom of the hole. Although the level of the fluid may not be lowered, it may be lightened by the removal of water and mud that may have remained. The swab also creates a semi-vacuum, as it rushes up the tubing, to further stimulate the movement of gas or oil into the well from the formation. From a few strokes to many days of swabbing may be necessary to clean up the hole and start the well to flowing on production.

Shooting, Acidizing and Fracturing

In some cases even the swab may not be enough to induce the well to produce due to the denseness or *tightness* of the formation. In earlier days, wells were loaded with nitro-glycerin that, on detonation, so shattered the formation as to cause gas and oil to enter the hole readily. In addition to the danger to life and the bore hole, there were frequently costly clean-out jobs required for removing the debris accumulating from the explosion. Consequently, other methods have largely replaced this type of *shooting*.

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Introducing the greatest advancements made to date in tractor mounted backhoes

Sherman Products announces *all new* digger for Ford Tractor with increased output to speed digging and reduce costs. New features make it faster with less maintenance and longer life.

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In limestone, inexpensive acids were found to be effective in opening the formation. From a few to several thousand gallons of acid are forced into the formation under pressure. The calcareous portions, being soluble in the acid, are removed and blown out at the surface by the *acid gas* created or by movement with the fluid as the well flows or is swabbed. Many prolific fields have been brought into production by this means.

A safer and more effective way of *fracturing* the rock is the pumping of liquids under extremely high pressures into the formation. Usually the pressures involved are in excess of those used in acidizing and will reach 15,000 psi or higher. The liquid employed for the job is usually crude oil with good flow qualities. The crevices opened by the pressurized fluid are generally longer, more narrow in width, and more numerous than those developed by nitro shooting.

Once the fracture has been made, it may close as the liquid is withdrawn. To prevent this and to establish permanent permability, round grains of sand are entrained with the fracturing fluid. This sand, in suspension, is readily conveyed into the fractured stratum with the fluid being pumped in under pressure. By withdrawing the fracturing liquid slowly the sand grains are entrapped to remain in their advance positions as "props" along the fracture planes. Much like miniature mine columns and cribbings, the sand grains hold avenues open for the traffic of gas and oil flowing to the well for production.

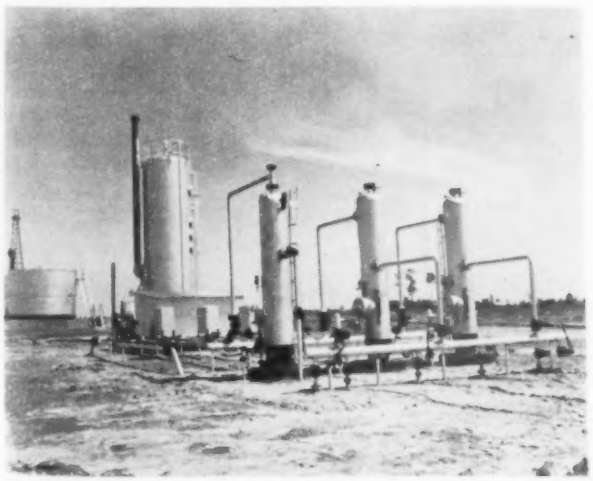
Packers and Squeezing

When it becomes desirable to put pressure on the formation through the tubing, without extending the pressure to all parts of the casing, a *packer* is used. This is the same device described for use in drillstem testing except that it is used inside the casing to close the *annulus* between the tubing and the casing. Thus, two spaces are segregated so that different pressures may be developed and contained within them as though they were separate vessels. This is an important aid in performing many of the tasks required in good well completion. Packers are frequently employed in acidizing, fracturing, and in squeezing.

This last operation is usually a remedial action. If the gas-oil ratio is too high — that is, if the volume of the desired product is too great in relation to the other — the section containing the less desirable petroleum phase is *squeezed off*. Or, salt water may be entering with the gas or oil and steps are required to stop its admixture.

Squeezing is accomplished by one of two techniques. Either all of the perforations are cemented closed, or packers are set in such a manner as to restrict the section of the stratum open to the flow of cement through the tubing. In the former case, new perforations must be made for both the squeezing of cement, under high pressure, into the undesirable portion of formation and for subsequent contact with the selected section for production.

The net result is the same — cement, under high pressure, enters and blocks that portion of the stratum that is producing unwanted water, gas or oil. Perforations are opened, or remain open by virtue of packer settings, to the valuable zone through which the unadultered product will flow if the squeezing or sealing has been properly done.



Gas and oil separators. This is a three-stage separation installation. In background, left, are stock tanks.

Pumping Wells

All commercial gas wells flow by virtue of the qualities of gas. However, gas may be depleted and the well may begin producing oil when both have been present in the reservoir. When oil can no longer be brought to the surface by the differential pressures (those existing in the formation opposed to atmospheric pressure plus the weight of the column to be lifted) it is necessary to resort to *secondary recovery*. This, ordinarily, involves pumping the well.

Solid rods, called *sucker rods*, are run down inside the tubing to activate, by an up and down motion, the working barrel of a pump near the bottom of the well. The working barrel of the pump moves snugly inside a machined barrel fixed in the tubing string. In the bottom of the cylinder is a simple ball and seat valve, called the *standing valve*, fixed in a cage. A similar valve, placed in the moving barrel, combines its action with the lower valve to permit a quantity of oil to be lifted on each stroke of the pump.

Movement is imparted to the sucker rods and the pump by a lever and fulcrum device variously referred to as the *pump jack, walking beam or pumping unit*. Essentially, a pivoted steel beam is balanced with the weight of the sucker rods and fluid load on one end and balance weights on the other. A relatively small amount of power is needed to move the beam up and down to pump the well. The rods are fastened to the end of the beam, over the wellhead, with a flexible bridle.

Surface Equipment

At the surface, *flow lines* connect the crude products of the well to the initial vessels for their treatment and temporary storage. Gas and oil produced together are conveyed through a *separator*, which delivers the gas, free of oil, to lines for subsequent processing. The oil goes to tanks, on the lease, for holding until it is measured out into the pipelines.

Traps are provided in the flow lines from gas wells to extract any liquids that may be in the gas. These *traps or drips* are designed so that changes in velocity and temperature aid in drying the gas before it is metered. The trapped liquids are drawn off either manually or automatically.

There are numerous other types of equipment for the preliminary cleaning of gas at the wellhead, such as scrubbers, but they all bear so much resemblance to the processing equipment to be discussed in this series that it is sufficient, at this point, to recognize their existence only. The purpose of drips and scrubbers and such devices is to clean the gas before delivery into the pipelines but the tendency has been to do less such extraction at the wellhead and more at the processing plant. In the past, many valuable elements were lost by wasteful initial treatment. Now, as will be seen in subsequent chapters, everything of economic value from gasoline to sulfur is taken from the gas before it passes on for consumption as "dry" gas.

Acknowledgment

This chapter on "Completing the Gas/Oil Well" was prepared by W. K. Powell, president, Beard Drilling Company, Inc., Duncan, Oklahoma.

* * *

Vacuum vs Pressure Testing of Meters

Hilding V. Beck
American Meter Company
Philadelphia, Pennsylvania

THE method of proving gas meters with a bell prover has been employed since the introduction of gas as a fuel for producing light and heat. The usual or common method of test is to maintain a positive pressure of several inches of water column in the prover and pass this pressurized air or gas through the meter at essentially the same pressure.

This method is still used to a great extent by both meter manufacturers and by operating gas companies. With tin meters equipped with enclosed valves, this method permits proving the meter with the top removed and with the adjusting mechanism exposed for rapid adjustment.

The process of proving meters with the prover bell under a slight vacuum, or negative pressure, instead of under a slight positive pressure, is not new. This method has been used, on occasion, by various groups for many years. It was not until recent years, with the advent of open top tin meters, and welded meters, that this method of proving became widely used because of the particular advantage it offers — that is, permitting exposure of the tangent, linkage, and valves during the adjusting and proving operations. Since this mechanism is exposed, the method lends itself admirably to the use of mechanical or electronic devices in adjusting meters.

Proofs Must Be Adjusted

There is no fundamental flaw in the process, the only requirement being that meter proofs be adjusted to the customary basis; that is, of measuring the displaced volume at the inlet pressure — instead of at the outlet pressure. A definite adjustment to the meter proof can be made, depending upon the customary prover pressure.

Since atmospheric pressure corresponds to about 400 in. of water, each 1-in. of pressure drop will allow the air to expand by ¼ per cent. A cubic foot of air from a bell prover loaded to 1-in. of water will expand to 1.0025 cu ft when discharged to the atmosphere. Similarly, a cubic foot of atmospheric air will expand to 1.0025 cu ft of air if it is drawn into a bell prover that maintains 1-in. of water negative pressure, or vacuum.

For convenience, it has been customary to measure at conditions existing at the meter inlet, and since the hose and prover dry-well are sufficiently large to justify neglecting any pressure drop from the bell to the meter inlet, the volume displaced by the bell is considered as the proper amount that the meter should indicate for establishing the meter proof.

If the meter received a cubic foot of air directly from the atmosphere, without restriction, and if its proof were 100 per cent, the prover bell, (at a 1-in. vacuum) would indicate a volume of 1.0025, or an uncorrected proof of ¼ per cent slower than correct.

The correct proof, expressed as a percentage, would be the indicated proof multiplied by $(100.0 - 0.25\ x,)$ where x = the prover vacuum in inches of water.

In this method of proving, any restriction to establish a "check" or "capacity" rate is installed between the meter outlet and the inlet to the prover.

The correct proof, for all practical purposes, can be obtained by subtracting ¼ per cent from the indicated proof for each inch of prover pressure below atmospheric pressure. This straightforward analysis has been corroborated by numerous actual tests wherein meters have been proved in both ways, and the resulting proofs compared.

Method Is Satisfactory

Certain of the manual operations in proving meters under vacuum are different and might initially seem awkward to an operator experienced in the conventional method of proving meters. All of the operations and common meter tests can be satisfactorily performed, however, in this alternate method.

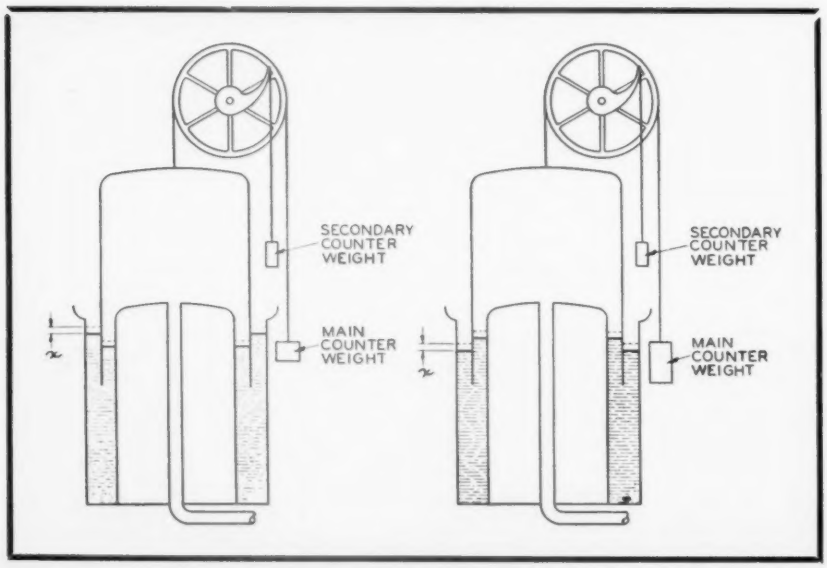


FIG. 1. Prover under positive pressure. FIG 2. Prover under negative pressure.

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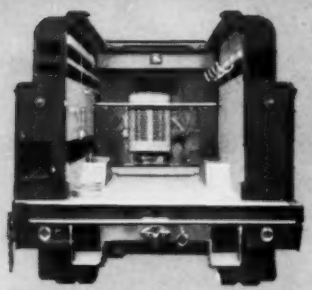

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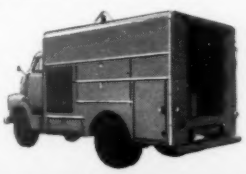

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The "high" pressure openings into the differential draft gage and prover gages, are open to the atmosphere while the "low" pressure openings are connected at the customary points in the test apparatus. The hose and connections are checked for leaks in the usual manner, the only difference being in the ability of isolated zone (between meter and prover valve) to hold a slight vacuum instead of a slight positive pressure.

The meter, connections, and hose are usually tested simultaneously by lifting the short flag arms from the tangent wrist, "one-pointing" the meter, and checking for the ability to hold a vacuum in the trapped volume formed by the meter and the prover hose.

Calibration Is Similar

For the same reason that a prover "bottled" at zero pressure is correct for measurement at a positive pressure, that same prover will be correct when measuring at a negative pressure. As long as the sealing fluid levels stay in the cylindrical inner and outer annular spaces, the prover will read correctly.

The secondary counter-weight on the cycloid arm will correct for the effect of buoyancy in either case. This is illustrated in Fig. 1 and 2, where the difference in fluid levels over the range of the bell travel is indicated by "x."

Fig. 1 represents the conventional prover arrangement, with a positive pressure in the prover bell.

Fig. 2 represents the prover loaded by the main counter weight so that a correspondingly negative pressure exists within the prover bell. In both cases, the same secondary weight is suspended from the cycloid arm to offset changes in buoyancy corresponding to various degrees of submergence of the bell.

Calibration by "strapping[1] — that is, by taking actual physical dimensions of the components and the sealing fluid levels, also yields an identical calibration for either pressure or vacuum proving.

One major precaution to be exercised in vacuum-proving concerns the sealing fluid level in the inner annular space. Since this inner fluid level is higher than the outer level, too much sealing liquid might permit the inner level to rise above the top of the cylindrical section of the dry-well that forms the inner annular space.

The resulting improper division of the inside and outside increments of displaced fluid volumes will cause a slight error in the displacement from the bell — it could also, under extreme conditions of excess sealing fluid, cause the fluid to be drawn over into the dry-well, creating a partial trap at the low point in the flow channel, thereby restricting free flow of air from the meter to the prover.

Under the careful conditions of operating displacement bell provers, which are necessary for accurate meter testing, none of the precautions on limitations outlined above prevent their satisfactory use when testing in this alternate manner. The many practical advantages corresponding to this method of testing would seem to justify its being more generally considered as a standard procedure.

Acknowledgment

This article was prepared from a talk presented at the AGA Distribution Conference, Chicago, 1956.

[1]This method of calibrating bell provers from physical measurements is described on Pages 104 and 105 in American Meter Company Handbook E-4, "Displacement Gas Meters." ★ ★ ★

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IN THE GAS UTILITY INDUSTRY

August

26-28 Appalachian Gas Measurement Short Course, West Virginia University, Morgantown, West Virginia.

September

3- 5 Pacific Coast Gas Association Convention, San Francisco, California.

4- 5 AGA operating section organization meeting, Sherman Hotel, Chicago.

6 New Jersey Gas Association, annual meeting, Spring Lake, New Jersey.

9-13 **AGA** Industrial Gas School, Hotel Penn-Sheraton, Pittsburgh, Pennsylvania.

10-11 Mid-West Gas Association, gas school and conference, Iowa State College, Ames, Iowa.

11-13 Natural Petroleum Association, annual meeting, Traymore Hotel, Atlantic City, New Jersey.

11-15 National Hotel Exposition, Coliseum, New York. (AGA will exhibit.)

12 NEGA safety conference, Hotel Statler, Boston, Massachusetts.

13-14 Maryland Utilities Association, 33rd annual fall conference, The Cavalier Hotel, Virginia Beach, Virginia.

17-18 AGA accident prevention conference, Sheraton-Jefferson Hotel, St. Louis, Missouri.

18-20 Southeastern Gas Association convention, Robert E. Lee Hotel, Winston Salem, North Carolina.

20-21 Public Utilities Association of the Virginias, annual meeting, Greenbrier Hotel, White Sulphur Springs, West Virginia.

23-25 ASME, fall meeting, Statler Hotel, Hartford, Connecticut.

October

1- 4 NACE, south central regional meeting, Municipal Auditorium, Oklahoma City, Oklahoma.

7- 9 AGA annual convention, Kiel Auditorium, St. Louis, Missouri.

10-12 ASME Fuels-AIME conference, Chateau Frontenac, Quebec, Canada.

16-18 Wisconsin Utilities Association, annual convention, Schroeder Hotel, Milwaukee, Wisconsin.

20 Oklahoma Utilities Association, gas division one day conference, Skirvin Hotel, Oklahoma City, Oklahoma.

21-25 National Safety Council, Conrad Hilton Hotel, Chicago, Illinois.

23 NEGA street department supervisors group, Hotel Bancroft, Worcester, Massachusetts.

November

4- 8 National Metal Exposition, Chicago, Illinois. (AGA will exhibit.)

6 NEGA Operating Division, Hotel Statler, Hartford, Connecticut.

11-14 American Petroleum Institute, Conrad Hilton Hotel, Chicago, Illinois.

11-15 National Electrical Manufacturers Association, Traymore Hotel, Atlantic City, New Jersey.

11-15 National Hotel Exposition, Coliseum, New York. (AGA will exhibit.)

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Prepared by Leo T. Parker, attorney at law and contributing editor

All Reasonable Contract Provisions Are Binding

Must Comply With Contract

Generally speaking, a purchaser, whether a gas corporation or other purchaser, is bound by any and all reasonable provision in a contract of sale. This is particularly true with respect to a time limit in which complaints of the quality of the merchandise shall be made.

For instance, in *J. A. Company v. Roseland Company, 128 So. 649*, the testimony showed that a company purchased from a manufacturer an appliance under a contract of sale that contains the following clause:

"This contract shall not be modified or added to by any agreement not expressly stated herein. A retention of the property after 30 days from its arrival at destination shall constitute a conclusive admission of the truth of all representations made by or for the vendor (manufacturer) and a fulfillment of all its contracts of warranty express or implied."

The company failed to return the appliance within 30 days, and also refused to pay certain notes given in payment on the contention that the salesman's representation and guarantee was not fulfilled by the manufacturer.

The court held the purchaser fully liable on the contract, saying:

"There is no suggestion that complaint was made within the 30 days, stipulated in the contract for a test of the machine, and it is beyond dispute that the machine was not returned to plaintiff, but at the time of trial was still in defendant's (purchaser's) possession. Where the contract provides that notice of defects must be given within a prescribed time or, as in the case here, that, if the merchandise does not function satisfactorily, it must be returned within a prescribed time from its receipt, or else the failure to so comply with the contract will be a conclusive admission of the fulfillment by the seller of all warranties, expressed or implied."

Employment Contracts

Modern higher courts consistently hold that ordinary contracts between salesmen and their employers are valid and effective, and must be construed according to legal rules applicable to other ordinary contracts.

For example, in a leading case, it was shown that a corporation entered into a contract with a salesman by the terms of which the corporation agreed to pay the salesman stipulated commissions on all "sales accepted." Litigation developed between the corporation and the salesman when the former refused to pay the salesman commissions on certain orders which it had refused to accept and deliver to the purchasers.

The higher court held the salesman not entitled to receive commission payments on the orders "not accepted" by the corporation, since the contract so clearly specified. The higher court said:

"The parties understood that commissions would be paid on all sales completed by deliveries and made on orders accepted by the defendant (corporation)."

For comparison, see *Cole v. Industrial Company, 157 S. E. 857*. In this case it was shown that Cole was appointed by a corporation through a written contract as "exclusive representative" for the sale of certain products in certain states for a period of 18 months, with the privilege of renewal from year to year. The contract contained a clause that the corporation had the right to refuse "any or all orders." The contract, also, contained a clause that the corporation would pay to Cole stated commissions "on all net sales accepted" by the corporation which came from the specified territory.

Litigation developed over payment of commissions and Cole sued the corporation to recover commission payments on certain orders actually accepted by the corporation but which were cancelled by the purchasers before deliveries could be made. In indicating that the salesman was not entitled to recover these commissions, the court said:

"The interpretation of construction given contracts by the parties to them is one of the best indications of their true intent and meaning, and the courts should ordinarily enforce such construction . . . The parties understood that commissions would be paid on all 'net sales,' that is, sales completed by deliveries and made on orders accepted by the defendant (corporation) for the territory mentioned in the contract . ."

Hence, it is well established that contracts between salesmen and employers are construed by the higher courts in accordance with the exact wording and formulation of the contract. If the contract is ambiguous the courts will seek to construe the obligations "intended" by the parties when originally the contract was signed.

Ever feel like this when an important legal question needed answering . . .?

For several months recently, Mr. Parker's very popular column hasn't appeared in these pages — and the deluge from our readers has been terrific — urging that it be resumed. With great pleasure we are resuming these summations of current higher court decisions on matters affecting gas utility operations.

We make no claims that these summaries will ever replace good legal counsel, but we know from our readers' experiences that they can be very helpful in finding the right answers.

If you have a question on some legal point, write us about it . . . we will try to get an answer for you.

— The Editors

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How To Lead Better Conferences

Alfred M. Cooper

THE MODERN industrial executive may spend as much as one-third of his working hours attending conferences. As often as not he will be the leader of these discussion meetings, as many will be departmental meetings, attended by the executive's subordinates. It is obvious that these meetings must be productive or they represent an appalling waste of effort.

It is true that it is much easier to see what is right or wrong about a conference when you are seated in the group, rather than at the head of the table. If you are observant at such a time, you can learn a lot about conference management.

Therefore, the next time you attend a conference check the points listed below and decide for yourself whether or not this one can be rated as a **good** conference: *One productive of many new ideas, sharp differences of opinion, and eventual group consensus on solutions to problems or courses of action to be followed.*

Here are the factors to watch for when you wish to evaluate the worth of any conference:

1. **Is the conference interesting?** A conference will have little lasting value unless the group members are really interested in the problems they discuss. There are a number of factors that determine the degree of group interest, and most of these are directly under the control of the leader.

First, the problem to be discussed must be of a nature that may reasonably be expected to interest this particular group. The leader selects the problems, and if he is the organizational superior, he also has quite a bit to say about selecting those who make up the group.

Then, the problems presented to the group must be so worded that their meaning is entirely clear to the group member. When necessary, supplemental material (typed, mimeographed, blueprinted, or developed on the blackboard) must be available to clarify the problem. Confusion of any sort as to the elements of the problem lowers interest and causes the members to talk at cross-purposes.

The group must be comfortably seated, lighting and heating satisfactory, no one facing glare, if possible in a regular conference room about a table.

There should be a minimum of conferences held in private offices, where the leader is seated behind his desk and the group is leaning back in chairs deployed about the walls of the room. Poor physical conditions for a conference can lower interest.

The leader himself may inadvertently kill interest by being too hard-boiled with group members, or he may instead be too wishy-washy. He can (and should) tell any group member when he is out of order (because he is attempting to monoplize the discussion, carrying on private conversations, or getting angry when disagreed with) but he can do this without creating antagonism.

If he fails to control the conference situation at all times the group loses respect for him, and interest in the proceedings.

The leader must not permit the discussion to wander from the subject. The group is at once aware when someone digresses, and they expect the leader to get the wanderer back on the subject without loss of time. If he does not, they realize the discussion is getting out of hand, and they lose interest.

The group's interest in any conference fluctuates from time to time, depending on many factors. Group members indicate interest by the amount of voluntary talking they do, by a healthy tendency to disagree, by the degree to which they interrupt one another, and by the attention they pay to the man who is talking.

Lack of interest is registered by constant fidgeting, tapping feet on floor, frequent glances at watches, and a general air of boredom amounting at times to acute suffering. It is not surprising that an uninteresting conference accomplishes nothing.

There is, in the conference situation, the possibility for a degree of interest that is almost unbelievable. It is based on the desire of every member of the group to express his convictions on some subject—a more powerful desire than his wish to listen to the opinions of anyone else on the subject.

2. **Does the leader call on group members for responses?** If he does, this is bad business. It is an indication that the leader knows no other way to get people to talk than by calling on them. The worst possible manifestation of this error is when the leader calls on group members left to right around the table.

The basic idea in the conference is that those participating will talk whenever they have anything to say worth saying. This is true even when a group member has language difficulties.

When you open any conference, sketch the general purpose of the meeting in a few words, and without giving the group any inkling of your opinion on these matters.

Then, within three minutes, put your first problem before the group. Now stop talking altogether and give the group time to think. Expect the first response to be rather superficial. Those who take more time may well come up with the best ideas.

Thereafter, let the group do most of the talking. The leader's participation factor should never exceed 20 percent, and this should almost entirely take the form of **questions.**

3. **Does the leader know how to phrase, and time the delivery of, follow-up questions?** Here is the crux of all good conference leadership. Watch the leader and see whether those little extemporaneous questions he uses are **phrased and timed** so that they fit smoothly into the discussion. They must slip in without disturbing the group's thought; indeed, they must provoke further thought. In no sense

should they indicate, even by voice inflection, a desired response.

Follow-up questions are most effective when the leader is thinking just a little ahead of the group. They should be short and pithy.

One of the very best is *"Why?"* and another good one is *"How?"*

A definite indication of the extent to which the leader has complete control of the conference situation is found in the way a group responds when he drops a capsule query into the discussion. If they ignore it, then he has lost control; if they follow the lead he has given them without hesitation, then his control is excellent.

4. **Does the group like and respect the leader?** A group likes a leader who proves he is openminded by not attempting to force his own views on them. They like him also if he keeps the discussion everlastingly on the subject. They very much like to have him give them credit for responses they have made, even though this takes only the form of a smile and a nod.

A group respects a leader who, at all times, shows he is in complete control of the conference situation. A group member may not be too happy if the leader requests him to drop a private conversation and address his remarks to the group, but he will respect that leader.

Again, it may become necessary for the leader to flatly request that a group member give somebody else a chance to talk. As a rule, too-loquacious people are fairly thick-skinned, and will take no offence. Thereafter, the response will be better-distributed. Such tactics, when called for, add to the group's respect for the leader.

The leader should aim for a nice balance between liking and respect. But if he can't get both he will do well to secure at least the respect of his groups.

5. **Has the leader really prepared for this conference?** As a conference proceeds it becomes evident whether or not the leader has given thought to what he hoped to accomplish in this meeting, in advance of the opening.

A conference should be planned as carefully as a public address, even though the leader is to do little of the talking.

The physical conditions for the conference (seating, ventilation, blackboard, etc.) must be checked in advance. Blackboards do not always have adequate white and colored crayon.

All materials for distribution to the group must be on hand. Permit interruptions from phone calls and messengers only in real emergencies.

The leader must give thought, in advance, to various possible turns the dis-

Veteran operator Delbert Corman "at ease" while his Cleveland is digging gas and water lines for a Lexington, Ky. subdivision

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First Speed	.5	.7	1.1	1.5	2	2.8	3.4	4.7	5.9	12.6	22.5	38
Second Speed	1	1.4	2.2	2.9	3.9	5.3	6.6	9	11.5	23.8	43	73
Third Speed	2	2.8	4.3	5.8	7.8	10.6	13.3	17.9	22.8	47	86	146
High Speed (Ordinarily used when digging)	3.3	4.6	7.1	9.5	12.8	17.5	21.7	29.6	38	78	143	240
Reverse (not used when digging)	.4	.6	.9	1.2	1.6	2.2	2.7	3.7	4.8	9.9	18	30

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cussion may take, and decide how he will meet these situations.

He cannot, in advance, actually phrase follow-up questions. But he can consider the general trend these should take, and thus have less difficulty formulating them when the time comes.

A suggestion with reference to planning: *There is danger that regularly scheduled departmental meetings may be convened whether or not there happens to be anything to discuss.* The leader should determine whether a particular meeting is justified; if not, call it off.

6. Is the group enjoying this conference? If a conference is properly conducted the group enjoys every minute of it. They like to attend a meeting that is interesting. They enjoy either participating in, or watching, a good fight, and there will occur genuine battles of wits in any good conference.

Differences of opinion stimulate thought. Only when there exists deadly agreement does the meeting become dull and boring.

There is no reason why humor cannot be injected into the most serious discussions. The leader may do this, preferably by pointing up something a group member has said so as to give it a humorous twist.

If a conference group is enjoying itself, those present would obviously rather be right where they are than anywhere else, and this is a situation to be desired at any conference.

7. At the conclusion of the conference did the group feel something worthwhile had been accomplished at that meeting? The leader should make an interim summing-up of the sense of the group's deliberations, about once every 15 minutes. This has the effect of bringing everyone up to date and also stops the rehashing of old arguments. Then at the close of the meeting, he should make a final summation, carefully outlining, and without any display or bias whatever, the two or more solutions offered by the group, and at once call for a vote.

Whenever practicable, it is excellent motivation to inform the group that executive action will be taken in accordance with the majority decision they have registered.

Next time you attend any conference check the work of the leader in terms of the seven points we have enumerated.

Then, next time you **lead** a conference, check yourself as the meeting progresses, and see if you can correct any faults that may have crept into your methods of leading a conference. The result may well be meetings that will be a pleasure to conduct, and altogether worth while for those who attend. ★ ★ ★

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Things to write for . . .

Bulletins, brochures, books of interest to gas utility industry people

Magic Nose — Sonic Gas Analyzer. Four-page brochure on the N. I. L.-Merck sonic gas analyzer is now available. Called "sonic" because it employs the velocity of sound to obtain exceptional range, sensitivity, and rapidity of analysis, the gas analyzer has just been released by the National Instrument Laboratories, Inc. Monitoring of gas mixtures by continuous or batch control, the detection of minute amounts of harmful gases in pollution or personnel safety problems, vapor and gas chromatography, and the study of isotope concentrations in certain gases are a few of the many applications of the analyzer. Unit exploits the wide differences in sonic velocity by achieving such measurable sensitivities as 0.005 percent of oxygen in air and 0.00061 percent of hydrogen. Usual linking of high sensitivity with limited ranges of gas concentration, typical of other types of analyzers, does not exist in the sonic velocity method. High sensitivity remains the same over the range of 0 to 100 percent. Single chassis construction of the basic unit permits installation in industrial plants where other apparatus is too delicate or too insensitive. *National Instrument Laboratories, Inc.*

CIRCLE (1) ON THE REPLY CARD

Construction Data. The 1957 edition of GAMA's "Natural Gas Construction Data," includes details for over 95 percent of the total natural gas pipeline mileage authorized by Federal Power Commission during 1956. Annual summary includes specific natural gas construction data on projects authorized by FPC during 1956; projects pending FPC action, January 1, 1957; names and addresses of operating utilities engaged in pipe construction; cities benefiting by 1956 authorizations; chart on natural gas reserves and production; summary of post-World War 2 expansion; chart on growth of the pipeline network; and summary of 1956 miles, cost, and estimated steel tonnage of natural gas pipeline projects authorized, completed, and operating. *Gas Appliance Manufacturers Association, Inc.*

CIRCLE (2) ON THE REPLY CARD

Pilot and Nozzle Catalogs. Hauck Manufacturing Company has issued two new catalogs — No. 811 on blast type pilots for ignition of industrial gas burners and No. 804-D and 804-LE "Retain-A-Flame" Gas Burner Nozzles, screwed and flanged types. *Hauck Manufacturing Company.*

CIRCLE (3) ON THE REPLY CARD

Hazard Finder. To help you locate the hidden probabilities of electrically ignited explosions in plants, Crouse Hinds Company has issued a eight-page, illustrated folder that contains a check list of 13 questions. These questions can help determine whether uncontrolled flammable gases, vapors, dusts, liquids, and other combustible materials are making your plant unsafe. Part of the folder is sealed until all the questions are answered. After the seal is broken, an evaluation of the hazard potential in your plant is revealed, based on your answers and the findings of the National Fire Protection Association. *Crouse Hinds Company.*

CIRCLE (4) ON THE REPLY CARD

Wall Chart of Conversion Factors. A reference table for engineers and executives in wall chart form has been published by Precision Equipment Company. Included are common conversions such as inches to centimeters or watts to hp as well as many conversions that are difficult to locate in reference manuals. Examples are atmospheres to kgs/sq cm, cm/sec to miles/hr, cu ft to liters, microns to meters, quintal to lb, etc. *Precision Equipment Company.*

CIRCLE (5) ON THE REPLY CARD

Plant Maintenance. The 1957 edition of "Techniques of Plant Maintenance & Engineering," has just been published. The 273-page book includes 29 papers presented by discussion leaders at the Plant Maintenance & Engineering Show. In addition, 890 specific problems are presented in the form of questions and answers. Subjects covered include changing requirements for maintenance, preventive maintenance, cost controls, shops, maintaining mobile handling equipment, maintenance of equipment standards, preventive maintenance of power distribution equipment, role of lubrication in preventive maintenance, organization, yardsticks by which to measure maintenance effectiveness, training personnel, maintenance in small plants, and maintenance welding. *$10. Clapp & Poliak, Inc.*

CIRCLE (6) ON THE REPLY CARD

Valve Catalog. New 244-page catalog covering Darling gate valves, check valves and fire hydrants in a broad range of types, sizes and constructions is now available. Catalog No. 57 supersedes Darling Catalog No. 17 which won published recognition for outstanding cataloging techniques. New catalog is equally well illustrated and diagrammed, and goes further than previous catalog in simplified presentation of useful data and referencing information. Covers Darling-McEvoy automatic self-sealing conduit gate valves, ball-bearing-operated dry-top hydrants and special-purpose corrosion-resistant valves and includes extensive engineering data, application tips, valve accessories information, and reference data on materials, specifications, and standards. *The Darling Valve & Manufacturing Company.*

CIRCLE (7) ON THE REPLY CARD

Industrial Truck Catalog. Complete line of fork-lift trucks, straddle carriers, powered hand trucks, and towing tractors produced by the Industrial Truck Division of Clark Equipment Company is described in a 16-page, four-color catalog just published by the company. Every machine is illustrated. Fork trucks treated include the Clarklift line, the standard line, and the new line of gas and diesel-powered pneumatic tire "Rangers." Specifications given on the eight straddle carrier models includes capacity, wheelbase, length, width, height, package height, package width, road speed and service weight. Units of the "Powrworker" line of electric-powered hand trucks treated include tuggers, pallet trucks, low-lift platform trucks, high lift platform trucks, and stackers. Eight towing tractors are described, including gas-powered, electric-powered, solid tree and pneumatic tire models. *Industrial Truck Division, Clark Equipment Company.*

CIRCLE (8) ON THE REPLY CARD

AGA Gas Range Feature-Finder. New edition of the AGA "Gas Range Feature Finder" chart shows at a glance the availability of various features on today's gas ranges and the names of 31 leading manufacturers offering them. Special features are limited to those which are in greater demand, and the chart does not attempt to show combinations of these on specific models. Included are two pages of dimensions for built-in and stack-on units. Free standing ranges are given in overall widths and depths. Colored enamel and metallic finishes are also indicated on the chart. All ranges listed on the chart have been awarded the "Seal of Approval" granted by the American Gas Association Testing Laboratories to those gas appliances that have passed exhaustive tests on safety, durability, and performance. *American Gas Association.*

CIRCLE (9) ON THE REPLY CARD

Underground Corrosion. Results of a 45-year study of underground corrosion conducted by the National Bureau of Standards is now available in a 227-page circular, "Underground Corrosion," by Melvin Romanoff. Superseding NBS Circular 450 issued in 1945, the final report contains both field and laboratory results. Up to 1922, the studies were confined to corrosion due to stray current electrolysis and its mitigation. After it became apparent that serious corrosion occurred in soils under conditions that precluded stray-currents as an explanation, a field burial program was intiated in order to obtain information pertaining to the effect of soil properties on the corrosion of metals. Approximately 37,000 specimens, representing 333 varieties of ferrous, nonferrous, and protective coating materials, were exposed in 128 test locations throughout the U. S. During this time the electrical and electrochemical aspects of underground corrosion, including cathodic protection have been continuously studied in the laboratory. Many references to industrial investigations and field experiences related to the Bureau's underground corrosion investigations are also included. *$3.00, U. S. Government Printing Office.*

CIRCLE (10) ON THE REPLY CARD

New Tool Catalog. Armstrong Bros. Tool Company has just released a new 120-page general catalog listing 4,980 tools for industry, including 500 new types and sizes never offered before. Included are complete lines of wrenches, socket wrenches, drop forged clamps, tool holders, set up and hold down tools, cutting tools and pipe tools. *Armstrong Bros. Tool Company.*

CIRCLE (11) ON THE REPLY CARD

Pipeline Valve Booklet. Illustrated in color, a new 12-page bulletin describes Grove Series G-4 fabricated steel Seal-O-Ring Pipeline Gate Valves for 6 to 36-in. lines, ASA series 150 to 600, WOG. An engineering and specification reference, booklet contains complete dimensional tables; charts and graphs to determine venturi valve flow rates and gas flow correction for gravity, temperature and supercompressibility; photographs and drawings showing details of design, construction, testing, operational features, and valve types; and material specifications. *Grove Valve and Regulator Company.*

CIRCLE (12) ON THE REPLY CARD

New Gas Heater Control. Dependable and silent performance of new combination control for high capacity gas home heating units is described in a bulletin now available from Robertshaw-Fulton Controls Company. Model HC-E, the gas heating control described, is especially designed for use on central heating furnaces with ratings up to 200,000 Btu an hour (natural gas). Unit combines positive snap-action gas valve, new-type valve actuator, automatic pilot, and built-in pilot filter. *Grayson Controls Division, Robertshaw-Fulton Controls Company.*

CIRCLE (13) ON THE REPLY CARD

Air Tool Trouble Chart. New 8-page bulletin explaining troubles encountered, causes, and remedies, when using rock drills is now available free. Bulletin AT-116B is titled, "I Know Airpower." In addition to the rock drill "trouble-shooting chart," two pages of the bulletin are devoted to growing usage of air as power. Pictures and drawings are used to illustrate construction and maintenance of various air tools. *Le Roi Division, Westinghouse Air Brake Company.*

CIRCLE (14) ON THE REPLY CARD

New Pilot Loading Applications. Newly revised 12-page photo-illustrated bulletin No. 1082 (Rev. 2) describing Rockwell's "014" low-pressure balanced valve regulators has been issued by Rockwell Manufacturing Company. Revised bulletin features include detailed schematic drawing illustrating use of Rockwell "173" high pressure regulator for pilot-loading of the "014" (a new application of the "173") and similar drawing showing Rockwell Type 39 Power Pilot Regulator (Standard) for the same purpose with help of new adapter that facilitates mounting. *Rockwell Manufacturing Company.*

CIRCLE (15) ON THE REPLY CARD

Utility Ditcher. Colorful 8-page catalog featuring the improved Gar Wood-Buckeye Model 403 utility ditcher has just been issued by Gar Wood Industries. Thoroughly illustrated with mechanical views of all major components, the catalog also includes action photos showing the ladder-type ditcher at work under a variety of conditions. *Gar Wood Industries, Inc.*

CIRCLE (16) ON THE REPLY CARD

Gas Range Catalog. Dixie Foundry Company has announced a new 18-page three color catalog of their gas ranges. Photographs, features, and specifications for the Dixie Thirties, Stylemasters, Budgetmasters, Dixie 300's, and Spacemasters are included. *Dixie Products, Inc.*

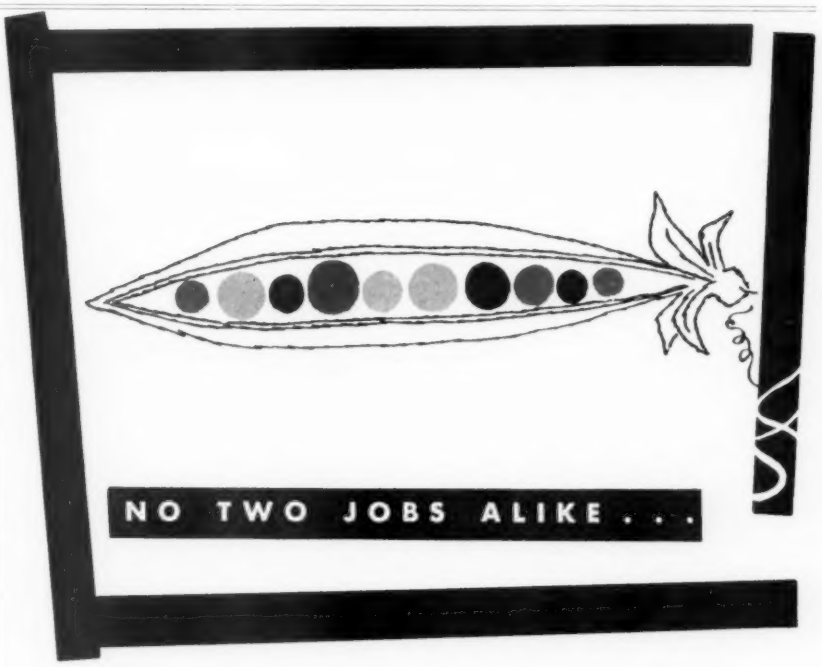
CIRCLE (17) ON THE REPLY CARD

Abrasive Cutoff Bulletin. Current revision of the Beaver Abrasive Cutoff Bulletin AB 457 gives specifications, excellent descriptions, illustrations, cutting times, and many other important features concerning the line of Beaver abrasive cutting machines. *Beaver Pipe Tools, Inc.*

CIRCLE (18) ON THE REPLY CARD

Tractor-mounted Rotary Drill. Davey Compressor Company has issued two new bulletins describing their new M-8TA tractor-mounted rotary drill. One, a single-page leaflet, contains detailed specifications. The other, a 4-page leaflet, describes both tractor and truck mounted units with rated capacities to 2000 ft. *Davey Compressor Company.*

CIRCLE (19) ON THE REPLY CARD



The successful completion of a Sheehan job — on time and on cost — is the result of careful planning and efficient operation by veterans in the construction of intermediary and connecting lines as well as the longer transmission lines . . . regardless of varying requirements for different jobs.

Sheehan "spreads" assure satisfaction simply through the use of the most modern and efficient methods, and through close attention to detail . . . every mile of the way.

Let Sheehan's experience work for you on your next pipe line project.

SHEEHAN PIPE LINE CONSTRUCTION CO. TULSA OKLA

SHEEHAN

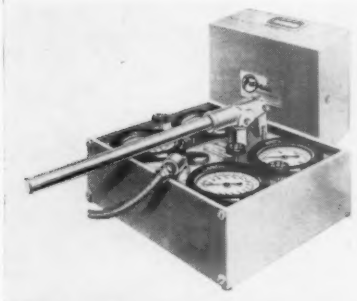
NATIONAL BANK OF TULSA BUILDING

TULSA, OKLAHOMA

Need this article for your files? Tear it out and tuck it away!

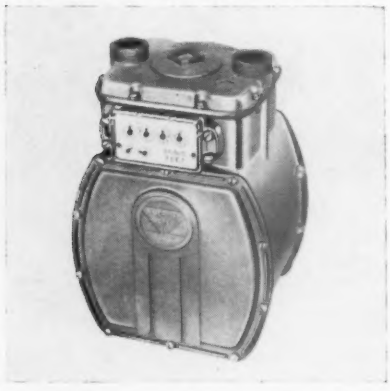
NEW EQUIPMENT
FOR THE GAS UTILITY INDUSTRY

For more information on items described here in brief, use the handy reply card and circle the corresponding numbers



For On-the-site Hydrostatic Testing. A "utility" version of the new Farris "Porta-Tester," weighing only 55 lb and contained within a carrying case, has been developed by Farris Engineering Corporation. The tester is designed for on-the-site hydrostatic testing of valves, pressure vessels, piping, and other process equipment to pressures up to 3000 psi. Completely portable, unit is only 18 by 14 by 8 in. and can be carried about like an overnight case. It is complete with four test-accuracy gages and 8 ft of hydraulic, flexible tubing that packages on the rear of the cover for complete portability. Pump handle folds flat for easy storage in the case. Unit can be used with water or other hydraulic fluids. *Farris Engineering Corporation.*

CIRCLE (61) ON THE REPLY CARD



For Sustained Accuracy — Slow Speed Aluminumcase Meter. American Meter has introduced a new meter that operates at only 7 revolutions per cu ft making it capable of sustained accuracy through greater power and slow-speed operation. Low operating speed of Model AL-250 insures minimum wear at vital bearing points, thereby reducing maintenance costs to a minimum over the life of the meter. Other advantages include large three-convolution molded Duramic diaphragms for use with all fuel gases and die-cast meter connectors which minimize galling. Its one-piece aluminum alloy, pressure die-cast body facilitates meter handling and setting, and reduces shipping weight. High impact strength, molded plastic index box gives full index visibility. Meter has rated capacity of 250 cfh of 0.64 sp gr gas at ½-in. water column differential and 5 psi rated working pressure. *American Meter Company, Inc.*

CIRCLE (62) ON THE REPLY CARD

How to Prevent Internal Corrosion of Stored Pipe—An economical way to guard stored pipe and tubing against internal corrosion has been devised by a Texas manufacturer. Slip-over and roll-on end caps made of neoprene effectively seal out air, moisture, corrosive fumes, dust, and small animals. Small amount of dehydrating agent added to the pipe before slipping on the fitted caps, protects the inside of expensive alloy tube stock from corrosion. Ideal for threaded pipe, the new caps retard drying of thread dope and keep the threads free of sand and grit. Two types currently available are a lightweight roll-on cap for 2 to 10-in. pipe and a heavier slip-on cap for 2 to 20-in. piping. The standard slip-on covers are about ⅛ in. thick. Unlike ordinary rubber, neoprene is highly resistant to oil, acids, and other chemicals, sunlight, and weather. *Protokap, Inc.*

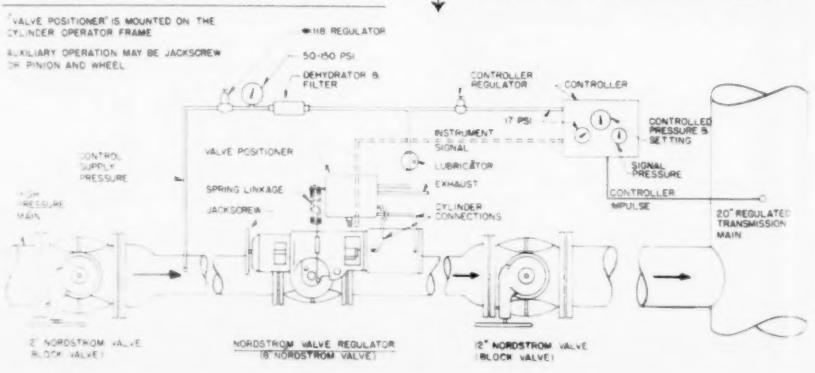
CIRCLE (63) ON THE REPLY CARD

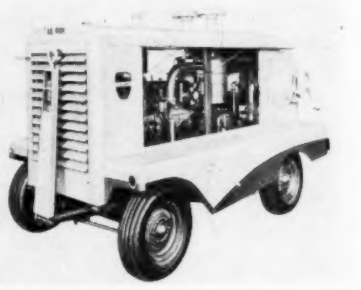
Motor Operated Valve. New England Gear Works has announced a motorized valve that incorporates the desirable features of automatic valve operation in one simplified, powerful, inexpensive unit. Available in ten sizes; ¼ to 3-in.—Jenkins bronze globe body; 3 voltages, 24 v., 115 v and 230 v, and 3 timing cycles. Unit is easily adapted to such applications as heating and air-conditioning processing. Unit features automatic disc compensation, extremely tight shut-off, 150 psi capacities on most sizes, no mounting restrictions, permanent lubrication, and quiet positive operation without linkage. Unit can be controlled by any positive action single-pole double-throw switch such as temperature, float, manual, time, program, or pressure actuated switches. *New England Gear Works.*

CIRCLE (64) ON THE REPLY CARD

New Power Inshot Gas Burner. Nu-Way Corporation has announced a new power inshot gas burner. Designed as Model G-200 and having an input range of 80,000 to 200,000 Btu per hour, the new gas burner has been made available after four years of comprehensive tests in both laboratory and field. It is AGA-approved. *Nu-Way Corporation.*

CIRCLE (65) ON THE REPLY CARD



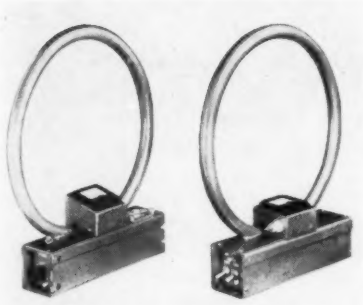


Lightweight Rotary Air Compressor. The lightest, shortest-turning 600 cfm rotary air compressor manufactured to date has been announced by the Le Roi Division of Westinghouse. Model 600RD2, the first of a new line of rotary air compressors, is a portable, two-stage, sliding vane type rotary air compressor that is rated at a free air capacity of 600 cfm. Dry weight is 7730 lb, and it has a turning radius of only 11 ft 11 in. The compressor is coupled to a GM-71 diesel engine with a hydraulically activated clutch. Engine-compressor is supported on a unit welded steel frame and is enclosed in a heavy metal housing. Another important feature is the unit construction. Side-by-side arrangement of individually cast cylinders provides compactness, ease of inspection, and greater accessibility than in-line or over-under cylinder arrangements. *Le Roi Division, Westinghouse Air Brake Company.*

CIRCLE (66) ON THE REPLY CARD

Valve-Regulator for High Pressure Gas Pipelines. A pneumatically controlled, cylinder-operated lubricated plug valve regulator, designed to provide high pressure gas regulation with minimum pressure loss, has been developed by Rockwell. Advantages of the new unit include operational ease, and favorable flow characteristics of the lubricated plug valve, high capacity with low pressure loss, silent regulation, and automatic pressure control. New regulating device consists primarily of a cylinder-operated Rockwell-Nordstrom valve with a pneumatic pressure controller and valve positioner. Increase or decrease of downstream pressure causes a change in the pressure controller output which in turn, causes the valve positioner to apply pneumatic power to the cylinder operator, thus repositioning the valve and controlling downstream pressure at the set point. *Rockwell Manufacturing Company.*

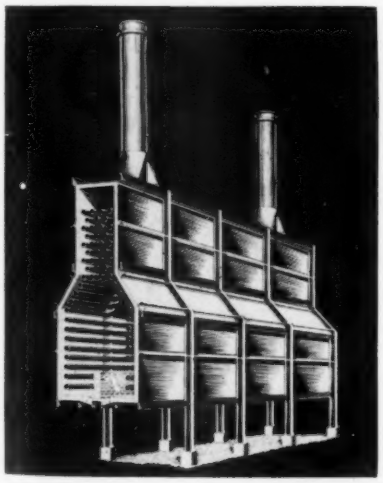
CIRCLE (67) ON THE REPLY CARD



Miniature Pipe Detector. Transistors and printed circuits have been utilized by OLTRON to produce a compact, low-current-drain instrument for detecting and tracing buried pipes, valves, or other metallic objects. No vacuum tubes are used. Three standard-type flashlight cells provide the entire power source. Unusually high sensitivity of the assembly is achieved by special high-gain tuned RF circuits in the transistorized receiver. The received signal is audible in earphones, and also presented visually on a panel instrument. Transmitter and receiver units are contained in small, sturdy metal containers designed as an integral part of the electrostatically-shielded pickup loops. Internal loop windings are impervious to moisture, hand capacity, mechanical shock, or vibration. Units are separate entities, may be operated remote from each other in the conventional manner to race out pipes, or sinapped together into a "fold out" hand-carrier assembly to detect unknown pipes or metallic objects. *OLTRON.*

CIRCLE (68) ON THE REPLY CARD

Low Cost Tubular Heater. Selas has developed an "Econotherm" heater, for non-critical continuous processing in the petroleum and petrochemical industries.



Previously furnished as special units, custom-built to meet specific conditions, the Econotherm heater design has been standardized to achieve the basic requirements of low first cost. An outgrowth of continued expansion of Selas' Fluid Processing Division, the new heater is intended to meet the increasing applications throughout the petroleum and petrochemical industries where heating is accomplished below decomposition temperatures, and where low first cost is an important consideration. *Selas Corporation of America.*

CIRCLE (69) ON THE REPLY CARD

ESTABLISHED
HALLMARKS
OF QUALITY

TECTION INC.

STANDARD PIPE

PAUL REVERE SR.
C.1730

YORK APOSTLE SPOON
C.1626

Richard Chaffers
1769.

EARLY craftsmen attested the purity of their products by stamping their individual hallmark on them.

We, too, affix our hallmark of quality coating and wrapping to the kraft wrapper of your pipe to assure you that it has been coated and wrapped according to procedures that establish the highest standard of quality for pipe protection.

WILLIAM CROSS
C.1688

CHOISY LE ROI
C.1795

CHANTILLY
C.1750

STANDARD PIPE

standard pipeprotection inc.
3000 SOUTH BRENTWOOD BLVD. • ST. LOUIS 17, MISSOURI

New Equipment

New Aluminum Wrench Line. New heavy duty forged aluminum pipe wrenches weighing less than half that of comparable malleable or steel wrenches have been announced by Toledo Pipe Threading Machine Company. New line is available in popular sizes 10, 14, 18, 24 and 36-in. and features aluminum handle, housing and hook with replaceable forged steel insert jaws and forged heavy duty nut on sizes 10, 14, and 18-in. A choice of forged aluminum housing and handle, forged aluminum hook with forged steel replaceable jaw inserts or forged steel hooks are available on 24-in. and 36-in. sizes. *Toledo Pipe Threading Company.*

CIRCLE (70) ON THE REPLY CARD

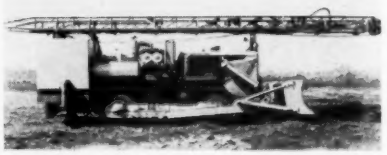
Construction Convertible. A new type of construction tool has been announced by Lorain that is fully convertible to shovel, crane, clamshell, drag and hoe. Model SP-107, a self-propelled machine mounted on a short coupled, square rubber-tire carrier with 4-wheel drive, requires no outriggers to develop a full-rated 7-ton lifting capacity in all positions of turntable swing. Four-wheel drive along with hydraulic power steering of the wheels on one axle has been provided. Power takeoff on the turntable is through an automatic transmission and torque converter. This coupled with the single speed transfer case on the carrier provides three travel speeds in both directions up to 15 mph. *The Thew Shovel Company.*

CIRCLE (71) ON THE REPLY CARD

Non-Shrink Permanent Insulating Couplings. New Pesco Insulating Couplings, consisting of a threaded sleeve molded of Plaskon nylon within a steel sleeve, have been designed for large-scale use by gas utility companies.

They serve as dielectric connections between sections of piping on gas distribution systems. Once installed, the couplings insure electrical isolation and eliminate corrosion, withstanding the shock of blows and jars, bending, side-thrust, and shock. Former obstacles to this type of coupling were high cost, shrinkage of the plastic with the coupling sleeve and other mechanical difficulties. Use of Plaskon nylon eliminates these obstacles. *Plastic Engineering & Sales Corporation.*

CIRCLE (72) ON THE REPLY CARD

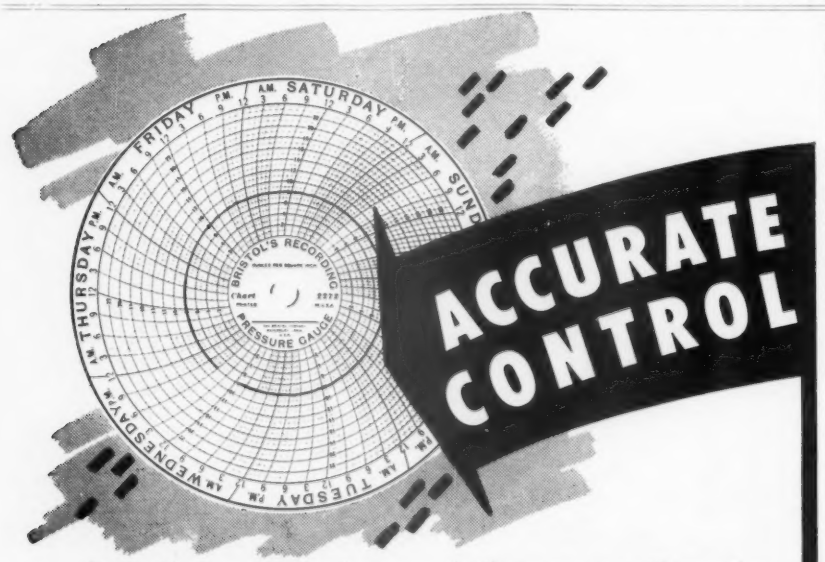


Tractor-Mounted Rotary Air Drill. Designed for extra heavy jobs under severe working conditions, Davey Compressor Company's new Model M-8TA has a rated capacity of 10-in. blast holes and 35,000 lb pull down pressure. Using compressed air for cleaning drilled holes, the rotary drill can also be used successfully as an air core drill. Attains higher rotating speeds (85-155-325 rpm normal drill bit speeds with 3-speed transmission) than is possible with other drills. Air pressures of 10 to 125 psi are available from a 6-cylinder Davey 500 cfm capacity compressor. Originally designed for mounting on either a new or used Caterpillar D8, the drill which weighs 58,000 lb can be adapted to other tractors of similar size. *Davey Compressor Company.*

CIRCLE (73) ON THE REPLY CARD

Combination Back Pressure and Anti-Suction Valve. Newly designed combination valve that controls both back pressure and suction on meters and distribution systems is available from Norwalk. New diaphragm assembly provides larger capacity and reduced pressure loss. Unit meets regulations of the increasing number of gas utilities and municipalities who require such a valve to control back pressure and suction caused by obstructions and shut-off of gas supply lines in gas compressor, gas booster, and similar installations. Two soft seated diaphragms give positive shut-off. Engineered for back pressures up to 50 psi in pipe sizes from ½ to 6-in. *Norwalk Valve Company.*

CIRCLE (74) ON THE REPLY CARD



Reynolds Service Regulators are built to meet specific requirements—years of operation in the field through a complete range of operating conditions have proved not only their superiority but their durability. With parts so precisely machined for each model that they are completely interchangeable. The accuracy you require in performance is assured.

MODEL 10

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accessible as to be interchangeable without removal from pipe line.

MODEL 20

Dead Weight or Spring Type, with or without Mercury Seal, or Dead Weight Safety Seal or diaphragm operated relief valve. All working parts are so accurate as to permit complete interchangeability in shop.

MODEL 30

For horizontal or vertical connections, with or without removable valve pocket. Available with either Spring or Dead Weight adjustment. With or without Mercury or Dead Weight Safety Seal or diaphragm operated relief valve.

Reynolds Gas Regulator Co.

ANDERSON, INDIANA, U. S. A.

GAS CONTROL SINCE 1892

Peak Shavings

. . . . with laughing gas

About the only thing you can look down on and approve of at the same time is a plunging neckline.

It is not enough to have a good aim in life; you have to pull the trigger, too. Which reminds us that big shots are just small shots who kept on shooting.

Most people can keep a secret; it's the folks they tell it to who can't.

A woman without principle usually draws considerable interest.

Now that the tourist season is beginning, it's time for the county to close the roads and open the detours.

According to a certain gas man, he'd had only two quarrels with his wife — the rest were the fiercest fights you ever saw.

Hangover: Toot ache.

A man who can drive safely while kissing a pretty girl isn't giving the kiss the attention it deserves.

A little boy returned home from his first day at school and told his mother that he wasn't going back.
"Why not, dear?" his mother asked.
"Well," he said, "I can't read, and I can't write, and they won't let me talk."

Did you hear about the chorus girl that was so dumb she thought Miltown was a place in Pennsylvania?

When a man is being toasted at a banquet, he's probably being buttered up, too!

Hospitality is the art of making people feel at home when you darn well wish they were.

SIGNS OF THE TIMES — In a shoe repair shop: "We Bring Back Departed Soles!"; in a department store: "Bath Towels for the Whole Damp Family."; on a farmers gate: "We Sell Real Fowl Eggs."

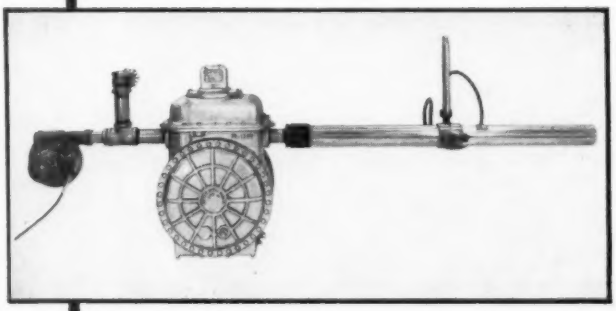
Little William had been late to school for the past week and when he came in Friday morning at 10:30 the teacher just threw up her hands.

"What's your excuse this morning? And I want the truth. Why are you so late?" the teacher asked.

"Well," stalled William, "last night Dad heard something out in the chicken yard. He got out of bed, picked up his gun and the lantern, and without his clothes he went out to the chicken yard. He put the lantern down and stooped over to look into the chicken house and old Rover cold nosed him. I've been picking chickens all morning."

HANDBOOK ISSUE will be ready September 15 — Don't miss it!

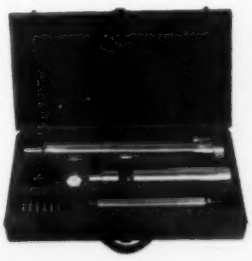
Prove Displacement Meters In the Field Quickly and Easily with AMERICAN® Flow Provers



Precision-built American Flow Provers provide quick and accurate proof testing of high capacity positive displacement meters in the field. Lightweight and portable, American Flow Provers are provided in 2, 3 and 4-inch models.

American Low Pressure Flow Provers, designed for hardcase displacement meter proof testing with air or gas at pressures below 15 psi, are supplied with calibrated orifice discs with proving rates to 10,000 cfh. Where gas cannot be conveniently discharged into surrounding atmosphere, a portable blower may be used.

American Critical Flow Orifice Provers, designed for 250 psi working pressure, are available with calibrated orifice discs for volumes to 6,000 cfh.



Consult your American representative for full information.

AMERICAN® METER COMPANY
INCORPORATED (ESTABLISHED 1836)

GENERAL SALES OFFICE: Somerton, Philadelphia 16, Penna. • Albany Alhambra • Atlanta • Baltimore • Birmingham • Boston • Chicago Dallas • Denver • Erie • Houston • Kansas City • Los Angeles • Minneapolis • New York • Omaha • Pittsburgh • San Francisco • Seattle Tulsa • Wynnewood. IN CANADA: Canadian Meter Company, Ltd., Milton, Ontario • Calgary • Edmonton • Regina

SUPPLIERS TO THE GAS INDUSTRY for Ironcase, Tinned Steelcase, Aluminumcase and Welded Steelcase Meters • American-Westcott Orifice Meters Instruments • Reliance Regulators • Apparatus • Valves

Bethlehem Supply Company, subsidiary of Bethlehem Steel, has been named a distributor of oil field casing and tubing manufactured by Lone Star Steel Company. The deal, according to E. B. Germany, president of Lone Star, is a straight sales arrangement and covers only oil country goods. He squelched rumors that Lone Star might merge with other interests.

Germany pointed out that "Bethlehem Supply simply wants a portion of Lone Star's pipe production to augment its existing supply. We are happy to make a deal with this company because it is outstanding in the supply field and will do a fine job of servicing our customers. There is no more of a possibility of hidden motives in this arrangement than there would be in the case of any other manufacturer furnishing products to Bethlehem."

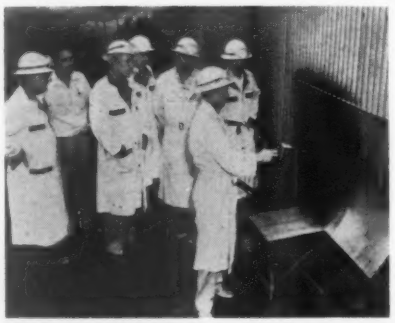
C. R. Zimmerman, executive vice president of Bethlehem Supply, confirmed Germany's statement. "Bethlehem Supply obtains a part of its line of merchandise from a number of independent suppliers: Lone Star is in that category as far as we are concerned, and we are proud to represent this fast-growing young steel mill."

Walter T. Moreland, vice president, sales, for Lone Star, said Bethlehem Supply will begin receiving small shipments of pipe in the near future but allocations to the new distributor may not become sizable until Lone Star's new stretch reducing mill and fifth open hearth furnace are completed and in operation. These facilities will add approximately 20 percent to Lone Star's pipe capacity, probably by January 1, 1958. Increased production created by these installations was the principal reason for adding another distributor.

Bethlehem Supply operates 65 sales offices and stores, mainly in the Mid-Continent oil and gas region. The firm also is represented in the Rocky Mountain area as well as California and Canada. Home offices are in Tulsa.

Principal Speakers Named for the 17th Annual Appalachian Gas Measurement Short Course include C. S. Stackpole, managing director of the American Gas Association, who will present the principal address; and H. B. McNichols of the Columbia Gas System Service Corporation, and James W. Chrisman of East Ohio Gas Company who are general chairman and program chairman, respectively. The short course, scheduled for August 26-28 at West Virginia University in Morgantown, will provide information on application, operation and repair of natural gas quantity measurement and pressure regulation equipment.

Robertshaw Announces Winners of "Contest Within A Contest." Winners of a three-part contest for gas utility promotion men sponsored by Robertshaw-Fulton Controls Company are: A. G. Baker, Intermountain Gas Company, in the up to 50,000 meters class; Dick Sievers, Central Electric and Gas Company, in the 50,000 to 100,000 meters class, and L. D. Burdick, Iroquois Gas Corporation in the over 100,000 meters class. Each will receive a $250 cash prize for obtaining the best local participation by homemakers in the annual "Mrs. America" contest this year. The number of utility entries in this "contest within a contest" indicates a greater interest in the nationwide "Mrs. America" activity this year than ever before.



Steady As She Goes — Distributors from Louisiana, Oklahoma, and Texas learn more about corrosion prevention at a short course given by the Protective Coatings Division of Pittsburgh Coke & Chemical Company at its Neville Island plant. Frank S. Staught, Pat O'Neal Enterprises, is shown applying Tarset, a patented combination of coal tar and epoxy resin, for combating severe corrosion conditions. Watching are left to right: John G. Brich, assistant manager of sales, and George Gallick, research and development laboratory technician, who together conducted the course; Lee Ford, S. D. Day Company; J. Ford Reilley, Construction Materials, Inc.; H. L. Stockdale, Stockdale, Inc.; and Clem Straughan, Midwestern Pipeline Products Co.

John Wood Company Has Added a New distributor of automatic water heaters in Tennessee. C. M. McClung and Company is one of the leading distributors of water heaters in the Knoxville, Bristol, and Chattanooga area, and their addition of the John Wood line marks a step in the expansion of John Wood Heater and Tank Division wholesaler outlets.

Gas Water Heater Shipments Lower in May. Manufacturers of automatic gas water heaters shipped 238,600 units in May, 2.3 percent fewer than the May 1956 figure of 244,300, the Gas Appliance Manufacturers Association has announced.

On the East Coast — Rhode Island Slated for underground storage project. Suburban Propane Gas Corporation has secured options on land in the Arnold's Point Section of Portsmouth, Rhode Island, in order to explore the possibilities of creating an underground storage for liquid hydrocarbons. If the formation is found to be suitable, the company plans to store a reserve supply of products in mined caverns. Geologists will soon start to take core samples of the property to determine whether it has the proper geological structures for this purpose.

On the West Coast — California Furnace Manufacturer to fire up operations as "a new, major Western source of quality forced air gas heating equipment." Tamco Corporation of San Rafael, has combined the facilities of two well-known California furnace manufacturers under the Tamco name: Barnes Heating Equipment Company, Inc., and Henderson Furnace and Manufacturing Company. Both Barnes and Clipper furnace brand names will be continued by Tamco with distribution extended to include Western and Southwestern states and Texas and Oklahoma. Officers of the new corporation are: John Hendrickson, president; E. Spurling, vice president and general manager; Phillip A. Kennedy, secretary-treasurer; B. Clyde Watts, vice president-engineering and production, and Walter M. Boland, vice president-marketing.

Executive Offices of Robertshaw-Fulton Controls Company, now at Greensburg, Pennsylvania, will be relocated in early fall in Richmond, Virginia. Among reasons listed for the move are: (1) The need to maintain closer liaison with government agencies and departments; (2) generally better geographic location with respect to the company's manufacturing division at Milford, Connecticut, Philadelphia, Knoxville, and other points in the East; and (3) good air transportation facilities for company personnel in Richmond.

Dresser Builds New Plant In Two-fold Expansion Program

Dresser Manufacturing Division has adopted a two-part expansion program designed to help solve the gas utility industry's problem of increasing demands for gas service.

Plans include a completely new million dollar plant in Wellsboro, Pennsylvania, to manufacture compression fittings for gas service lines. This will be the first time in Dresser's 77-year history that manufacturing operations will be carried on outside the home Bradford factory.

Also, the home Bradford plant has been enlarged to permit a 15 percent production increase. With 33,000 sq ft of space available and a complete relocation and modernization of existing production lines, Dresser will be able to substantially increase its output of repair clamps, and sleeves, saddles and other products essential to the gas industry.

Second part of Dresser's plan to serve the gas industry better is the improvement of existing products and the design of new products which the gas utilities need. New products recently introduced include an insulating connector for setting gas meters and regulators which provides the necessary rigidity for meter setting as well as resisting pull-out from the strains of basement piping; a convertible service tee, available in 56 varying combinations that can be converted from a service connection to a shut-off simply by replacing the valve assembly with the brass sealing plug; new "Wall-Seal" to meet requirements of Section 8 of the ASA B31.18-1955 Code that consists of two compression follower units, two wedge gaskets and a nipple threaded in each end to be supplied by the utility or to accommodate any variations in length required. Tightening the end nuts compresses the gaskets around the service line, providing a bottle tight seal.

The new million-dollar Wellsboro plant has 100,000 sq ft of manufacturing space that will be equipped with specially designed, high speed, largely automatic machinery. This equipment is currently being installed and full production is expected shortly.

American Gas Association Nominates New Officers

Thirty top executives from member gas companies in the U. S. and Canada have been nominated to serve as officers and directors of the AGA for terms beginning in October.

The slate of nominees will be submitted to delegates at the 39th annual convention October 7-9 in St. Louis.

Offices to be filled include those of president, two vice presidents, treasurer, 15 directors, and 11 chairmen and vice chairmen of the AGA's accounting, general management, industrial and commercial gas, operating, and residential gas sections. C. H. Zachry, current president, will automatically become a director at the expiration of his term of office.

Nominated are: **General Officers** — *president, A. W. Conover,* president, Equitable Gas Company, Pittsburgh; *first vice president,* Robert W. Otto, chairman of the board, Laclede Gas Company, St. Louis; *second vice president,* J. Theodore Wolfe, president, Baltimore Gas and Electric Company; *treasurer,* Vincent T. Miles, treasurer, Long Island Lighting Company, Mineola, New York; *directors,* Philip E. Beckman, vice president in charge of gas operations, Pacific Gas and Electric Company; Sheldon Coleman, president, The Coleman Company, Inc.; Clifford V. Coons, executive vice president, Rheem Manufacturing Company; R. E. Crawford, president, Minnesota Valley Natural Gas Company; Robert E. Ginna, president, Rochester Gas & Electric Corporation, H. Hansell Hillyer, chairman of the board, president and general manager, South Atlantic Gas Company; Chester L. May, senior vice president, Lone Star Gas Company; S. H. Nichols, president, Iroquois Gas Corporation; Ed Parkes, executive vice president, United Gas Corporation; John C. Parrott, president, Roanoke Gas Company; John C. Peterson, president, The Manufacturers Light & Heat Company; Edward H. Smoker, president, The United Gas Improvement Company; Henry Tuttle, president, Michigan Consolidated Gas Company; S. D. Whiteman, president, Kansas-Nebraska Natural Gas Company, Inc., and D. K. Yorath, president, Northwestern Utilities, Ltd.

Section Officers will hold office one year. *Accounting section* — chairman, D. W. Peterson, secretary and treasurer, Minneapolis Gas Light Company; vice chairman, J. Gordon Ross, manager of service and customer relations, Rochester Gas and Electric Corporation. *General Management section* — chairman, John H. Wimberly, president, Houston Natural Gas Corporation; vice chairman, Marvin Chandler, president, Northern Illinois Gas Company. *Industrial and Commercial Gas section* — chairman, Roy E. Wright, director of gas sales, NEGEA Service Corporation; vice chairman, F. T. Brooks, sales manager, industrial sales department, Philadelphia Electric Company. *Operating section* — chairman, V. F. Bittner, assistant chief technical engineer, The Peoples Gas Light and Coke Company; vice chairman, H. C. Jones, gas engineer, New England Electric System, gas division, Malden, Massachusetts; second vice chairman, J. T. Innis, vice president in charge of operations, Northern Natural Gas Company. *Residential section* — chairman, A. G. Bur, vice president in charge of sales, Wisconsin Public Service Corporation; vice chairman, Thomas H. Evans, vice president, sales, Equitable Gas Company.

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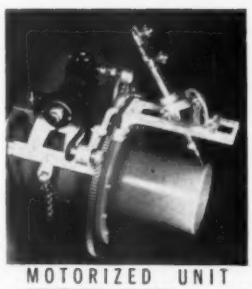
FLEXIBLE SHAFT



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The FLEXIBLE SHAFT attaches quickly and easily to any H & M machine, and allows the operator a full view of the circumference of any size pipe, while regulating the speed of the torch.

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Sixteen GAMA Divisions Elect New Officers

Newly elected division chairmen and vice chairmen of the various divisions of the Gas Appliance Manufacturers Association are:

Automatic Controls Division: *chairman* — S. L. Kile, executive assistant of Baso Inc.; *vice chairman* — Fred Weldon, regional sales manager of General Controls Company.

Direct Heating Division: *chairman* — Milton T. Clow (re-elected), manager of gas appliance department of James B. Clow & Sons; *vice chairman* — E. M. Douthat Jr., sales manager of Locke Stove Company.

Domestic Gas Range Division: *chairman* — John P. Wright, president of Florence Stove Company; *vice chairman* — A. B. Ritzenthaler, vice president of Tappan Stove Company.

Gas Appliance Regulator Division: *chairman* — Wayne Schutmaat, design engineer of Penn Controls, Inc.; *vice chairman* — Frank Fiedler Jr., sales manager of Thermac Company.

Gas Boiler Division: *chairman* — E. T. Selig Jr., director of engineering of Burnham Corp. Boiler Division; *vice chairman* — W. W. Popyk, manager of engineering service of National-U. S. Radiator Corporation.

Gas Clothes Dryer Division: *chairman* — John W. Benson (re-elected), sales promotion and advertising manager of Whirlpool-Seeger Corporation; *vice chairman* — Leroy Klein (re-elected), vice president of Caloric Appliance Corporation.

Gas Conversion Burner Division: *chairman* — H. P. Mueller Jr., vice president in charge of sales, Mueller Climatrol Division of Worthington Corporation; *vice chairman* — Charles R. Reichelderfer, director of engineering of Waterman-Waterbury Company.

Gas Furnace Division: *chairman* — E. P. Hayes, vice president of C. A. Olsen Manufacturing Company; *vice chairman* — E. W. Gettinger, products engineer of American Furnace Company.

Gas Incinerator Division: *chairman* — William R. Hebert, vice president of Calcinator Corporation; *vice chairman*—E. O. Olsen, national sales manager of Bowser Incorporated, Incinerator Division.

Gas Meter & Regulator Division: *chairman*—Thomas J. Watt of Sprague Meter Company.

Gas Unit Heater & Duct Furnace Division: *chairman* — Robin Bell of Surface Combustion Corporation; *vice chairman* — W. R. McMahon, chief engineer of Modine Manufacturing Company.

Gas Valve Division: *chairman* — Norman J. Reiff (re-elected), vice president of W. J. Schoenberger Company; *vice chairman* — Howard Goss (re-elected), sales manager of Harper-Wyman Company.

Gas Wall & Floor Furnace Division: *chairman* — A. J. Horne of Day & Night Division of Carrier Corporation; *vice chairman* — Robert Putman, vice president of Quaker Heating Division of Florence Stove Company.

Gas Vent & Chimney Division: *chairman* — B. A. Johnson, vice president of Condensation Engineering Corporation; *vice chairman* — William L. Morgan, director of engineering of American Metal Products Company.

Relief Valve Division: *chairman* — A. F. Craver, manager of The Patrol Valve Company; *vice chairman* — Everett N. Garrett, plant superintendent of The Welsback Corporation.

Industrial Gas Equipment Division: *chairman* — E. J. Funk Jr., vice president of the C. M. Kemp Manufacturing Company; *vice chairman* — Robert C. LeMay of the Selas Corporation of America; and *executive committee member* — James H. Sands, executive vice president of Eclipse Fuel Engineering Company.

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- Give Dependable Service

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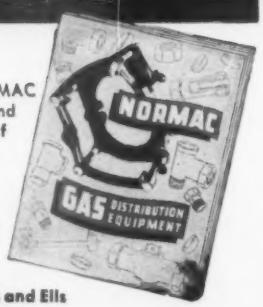
- Ease of "Stabbing"
- Complete Confinement of Rubber



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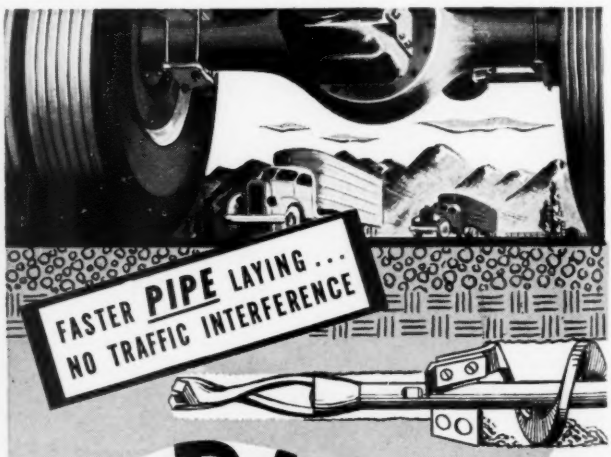

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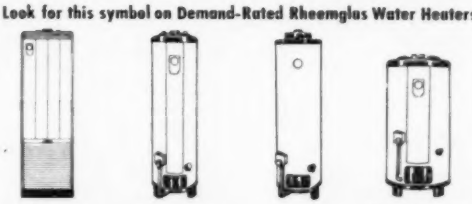

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Men At Work IN THE GAS UTILITY INDUSTRY

A. G. "Sam" Ford (third from right) displays the "lunch bucket" he received from Northern Illinois Gas Company associates as he retired recently. The gift, made from the top portion of a gas meter, is being shown to associates, left to right, Harold Schwalm, superintendent of supply, Glenn Kirk, superintendent of distribution, Loren Tuttle, manager of operation, Otto Jensen, superintendent of construction, and Ken Stanton, chief engineer. Ford was assistant manager of operation at the time of his retirement.

● **J. E. Coleman** has been elected vice president and general manager of Manufacturers Light and Heat Company. He will also serve in the same executive capacity with Cumberland and Allegheny Gas Company, and Home Gas Company.

J. E. Coleman

C. E. Brown

● **Carleton E. Brown** has been appointed to handle market research and development for Southern Counties Gas Company. He succeeds **Robert M. McIntyre** who recently was appointed sales manager of Orange County division.

● In preparation for the advent of natural gas, five promotions have been announced by Peoples Gas System of Florida. **Ivan E. Ball** has been promoted from vice president-comptroller to financial vice president-system; **George V. Justin,** formerly director of operational planning, has been promoted to vice president-operations-system; **Charles W. Davis,** formerly superintendent of the gas manufacturing plant at Fulford, has been promoted to director of operations, Peoples Water and Gas Division; **Herbert T. Young** has been promoted from assistant superintendent of the Fulford plant to superintendent; and **Rodney R. Little** has been promoted from maintenance foreman to general foreman of the Fulford plant.

● **Fulton W. Copp,** former manager of rates and sales, has been elected to the position of vice president for sales of Pacific Northwest Pipeline Corporation.

● **Milford H. Luttrell** has been named general sales manager of the Walworth Company.

● **John R. Lenox,** formerly an administrative official of Minneapolis-Honeywell Regulator Company, has been elected vice president in charge of operations, of Datamatic Corporation, wholly-owned subsidiary of Honeywell.

● **William H. Cochrane** has been elected a director and joined the management staff of Neptune Meter Company as executive vice president. Cochrane assumed the duties of this newly created office effective July 1.

● The Patrol Valve Company has appointed **Howard C. Brister** of Glendale, California, as their representative for Southern California.

● Brooklyn Borough Gas Company has announced that **Mrs. Helen S. Steers,** a member of the board of directors, treasurer, secretary and sales director, retired July 1 after more than 43 years of active service.

● **Thomas T. Arden** has been elected president and **John A. Robertshaw,** former president, has been elected chairman of the board of Robertshaw-Fulton Controls Company. A three-man executive committee headed by **Richard S. Reynolds Jr.,** former chairman of the board, has been formed that includes Robertshaw and Arden.

Thomas T. Arden

● **R. B. Stone** has been appointed vice president and sales manager of Dura-Vent Corporation of Redwood City, California. He will headquarter in Louisville, Kentucky, but will retain sales offices in Chicago.

● **Lester T. Potter** has been elected president of Lone Star Gas Company succeeding **D. A. Hulcy** who will continue with the company as chairman of the board.

● **Frank N. Seitz** has been elected to the board of directors of Southern Counties Gas Company.

● **R. G. Barnett** has resigned as director of Portland Gas & Coke Company and retired as vice president effective August 31 because of ill health.

● **William M. Wilkinson** has been named president and **Seth T. Roberson,** vice president of Natural Gas Odorizing, Inc.

● **George W. Stevenson,** manager of West Coast operations has been appointed vice president of American Meter Company. He will continue in charge of sales and manufacturing activities in Washington, Oregon, California, Arizona, Nevada, Idaho, and the Hawaiian Islands.

● Dresser Manufacturing Division has announced recent personnel changes: **Donald V. Hackett,** former district gas manager of Denver, has been transferred to Chicago as district manager. **Percy L. Knott** has been appointed gas market district manager for the Pennsylvania, Ohio, and West Virginia tri-state area.

● **Boyd N. Gee** has been named West Coast sales representative of the steel valve division of Kerotest Manufacturing Company.

● **Don S. Permar** has been named to the newly-created position of assistant general sales manager for the Le Roi Division, Westinghouse Air Brake Company of Milwaukee.

D. S. Permar

D. R. Gannon

● **Dan R. Gannon** has been appointed field sales manager of Mueller Company. In his new position, Gannon will direct field sales activities throughout the nation.

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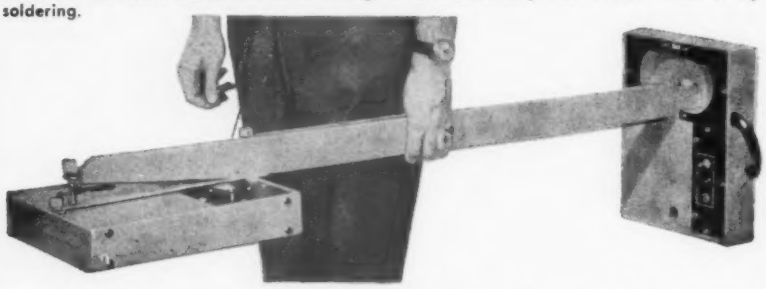
PREVENTS COSTLY DAMAGE

Spots all sub surface pipes, cables, etc., and determines their depth accurately.

ETCHED CIRCUITRY: instead of hand wiring, insures uniformity and freedom from faulty soldering.



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● **Elmer R. Weaver,** chief of the gas chemistry section of the National Bureau of Standards, recently retired after 45 years service. A nationally known authority in his field, he developed techniques for determining the performance of gas-burning appliances that are now used as basic procedures in approval testing of virtually every type of gas appliance sold in the U.S.

● **E. F. Rothel,** Mansfield district special representative, has been promoted to assistant district manager for Ohio Fuel Gas Company.

● **John W. Ostler** has been named president and director of Canadian Meter Company, Ltd., subsidiary of American Meter Company.

● **Leonard C. Smyth,** executive vice president of Roberts-Gordon Appliance Corporation of Buffalo, New York, and vice president of its Canadian affiliate has retired. He will remain as director and consultant of the corporation.

● **James N. Landis,** vice president of Bechtel Corporation, has been nominated president of The American Society of Mechanical Engineers. Other nominations to the posts of regional vice presidents and directors were: **Charles E. Crede,** Barry Controls, Inc., **Arthur W. Weber,** Corning Glass Works; **Ernest W. Allardt,** The Babcock & Wilcox Company; **Henry S. Aurand,** Lieutenant General, U. S. Army, Retired; **L. N. Rowley, Jr.,** Editor, *Power;* **Elmer O. Bergman,** C. F. Braun & Company, and **Ronald B. Smith,** The M. W. Kellogg Company.

● **E. A. Nash** has been appointed director of gas appliance sales of Norge Division, Borg-Warner Corporation. He will be responsible for merchandising Norge gas appliances with utilities throughout the country.

O. W. Manz Jr.

C. W. Meytrott

● **Otto W. Manz, Jr.,** has been elected executive vice president of Consolidated Edison Company of New York. **C. Wesley Meytrott** has been elected vice president of sales, succeeding Manz. Manz's election re-establishes the post of executive vice president which was abolished in 1955.

● Ohio Fuel Gas Company officers were re-elected recently. They are: **A. W. Lundstrum,** president; **E. D. Bivens,** vice president and general manager; **W. D. Betsch, W. E. Ferguson, I. A. Ludwig, C. C. Phillips, P. W. Rogers,** and **F. S. Williams,** vice presidents; **W. F. Laird,** secretary; **J. M. Rutherford,** treasurer and assistant secretary; **J. A. Bicber** and **W. F. Smiley,** assistant vice presidents; **D. B. Leach,** assistant secretary, and **H. S. Hahn, L. H. Longanbach,** and **Ohmer Ullery,** assistant treasurers.

● **Gordon O. Jerauld,** southern division general superintendent of Washington Natural Gas Company, has accepted a position in the gas department of Stone & Webster Service Corporation effective in August.

● **George E. Ludwig,** general manager of Michigan Consolidated Gas Company's Muskegon district, has been elected president of the Michigan Gas Association. Named vice president was **L. L. Perry,** vice president and general manager of Michigan Gas and Electric Company. Re-elected secretary-treasurer was **Milton G. Kendrick,** sales manager of Michigan Consolidated's Ann Arbor district.

● **John G. Williamson** has been named general manager of the gas department of The Kansas Power and Light Company in Salina, Kansas. He succeeds the late **Clifford E. Brock.**

● **James L. Potter** has been appointed sales representative in the Eastern U. S. for Maxitrol Company.

Hudson R. Searing

Hudson R. Searing, 62, chairman of the board of Consolidated Edison Company of New York, Inc., died June 26.

Clifford E. Brock

Clifford E. Brock, former vice president and director of The Kansas Power and Light Company, died June 1 in Salina, Kansas.

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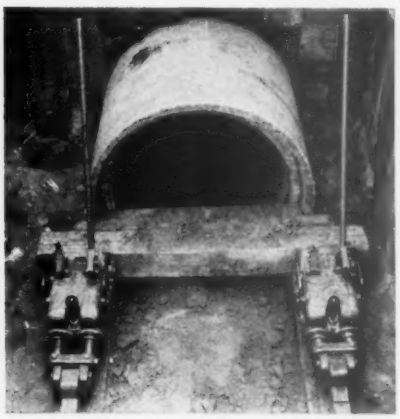

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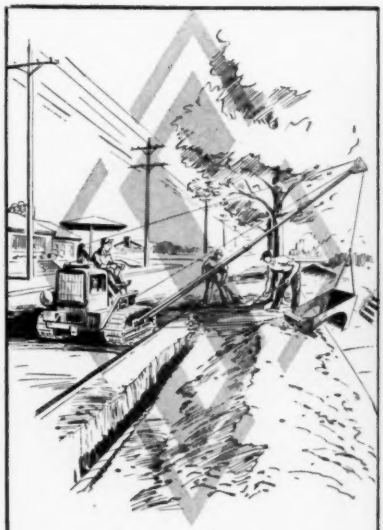
Index to ADVERTISERS

American Meter Company ..... Front Cover, 59
American Telephone & Telegraph 1
Aqua Survey Corp. ..... —
Athens Stove Works, Inc. ..... —
Chaplin-Fulton Manufacturing Company 11
Cleveland Heater Company ..... —
Cleveland Trencher Company, The 51
Connelly, Inc. ..... —
Dearborn Stove Company ..... —
Dresser Industries, Inc. 39
Dresser Manufacturing Division 39
Fisher Governor Company 34-35
Gas Equipment Manufacturers Committee ..... —
Gas Purifying Materials Company 65
Greenlee Tool Company 66
H & M Pipe Beveling Machine Company 61
Heath Survey Consultants, Inc. ..... —
Hills-McCanna Company ..... —
Hydrauger Corporation, Ltd. 62
Joslyn Mfg. & Supply Company 13
Koppers Company, Inc. ..... —
Lone Star Steel Company 47
McCabe-Powers Auto Body Company 45
McDonald, A. Y., Mfg., Co. 8
Midwestern Pipe Line Products Co. 48
Moonglow Gas Light Co. 65
Mueller Co. 5, 6-7
Norton-McMurray Mfg. Co. 62
Ohio Injector Company ..... —
Oronite Chemical Company ..... Inside Front Cover
Reynolds Gas Regulator Company 58
Rheem Manufacturing Company 63
Robertshaw-Fulton Controls Company ..... Inside Back Cover
Rockwell Manufacturing Company 9-10
Royston Laboratories 12
Safety Gas Main Stopper Co., Inc. 65
Sheehan Pipe Line Constructors 55
Sherman Products, Inc. 42
Skinner, M. B., Co. 31
Somerville Construction 66
Southern Cross Foresters ..... —
Sprague Meter Company, The ..... Back Cover
Standard Pipeprotection, Inc. 57
Superior Meter Company 49
Tapecoat Company, The 52
United Engineers & Constructors, Inc. ..... —
Universal Controls Corporation ..... —
Wilkinson Products 64
William Wallace Company ..... —

THIS INDEX IS PROVIDED AS AN ADDITIONAL SERVICE FOR OUR READERS — THE PUBLISHER ASSUMES NO RESPONSIBILITY FOR ERRORS OR OMISSIONS



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